News about

B.F.Goodrich Chemical *raw materials*

★ new high-tack Hycar

★ specification compounding

★ liquid GR-S polymer

One of the new applications *of Hycar American Rubber is for the liner sections of a centrifugal separator. Here Hycar withstands an abrasive stream of sand and mud, plus entrained oil and gas.*

NEW HIGH TACK HYCAR COMPOUND FOR SPECIAL USES. Hycar 1042 has recently been developed for applications requiring a high building tack—drum and tank linings, roll building, hose fabrication, etc. The improved tack is a result of the combined action of Plasticizer KP-555 and Hycar 1312, a liquid nitrile polymer. Hycar 1312 also improves knitting of stocks during molding and curing. A filler with a long needle-like structure (Pyrax A) inhibits blistering by allowing the escape of air during the calendering operation.

Compounding is not critical, and ingredients can be modified within fairly flexible limits to obtain physical properties desired for the application. The following recipe is recommended as a basic formulation for high tack compounds:

Hycar 1042	100.0
HBS Zinc oxide	5.0
Sulfur	2.5
FEF Black	40.0
Pyrax A	20.0
Hycar 1312	20.0
KP-555	20.0
TMTM	0.6
NBS Stearic acid	1.0
	209.1

Note: Compound possessed very good tack.

SPECIFICATION COMPOUNDING TO MEET DIFFICULT PRODUCT REQUIREMENTS. Despite the fact that the Hycar nitrile rubber family includes a broad range of types, requests for specialized properties are continually received. This is where our Product Application Laboratory steps in to develop and evaluate specialized compounds. Two recent such developments are of interest:

A low-swell, oil-resisting compound was requested for an accumulator bladder for hydraulic pressure systems. It was essential that tensile strength and elongation would be retained after oven aging, since the bladder is subjected to heat and alternate increase and release of pressure. Two compounds proved satisfactory, one based on Hycar 1042, the other based on Hycar 1002.

A compound that maintained properties upon immersion in fuel was requested for a gasket application. A compound based on Hycar 1041 and 1042 showed a volume swell of only 1%, and no change in hardness, after immersion for 60 days in Reference Fuel B, followed by 30 days drying.

LIQUID GR-S POLYMER LOWERS VISCOSITY OF STANDARD GR-S. Ten to fifteen parts of Hycar 2000X68, a liquid GR-S polymer now in production, can be substituted for an equivalent amount of standard GR-S to lower the Mooney viscosity of the mixture to that of GR-S 1010. Since the latter is premium priced and difficult to manufacture, the liquid polymer should be useful and economical in many applications.

Another use where the liquid polymer can prove valuable is in substituting for part of the Hycar in recipes to improve processing characteristics, in compounds where high hardness is desired in the cured state.

For further information on Hycar nitrile rubber, write Dept. EP-3, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ont.

Hycar
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American Rubber

B.F.Goodrich Chemical Company
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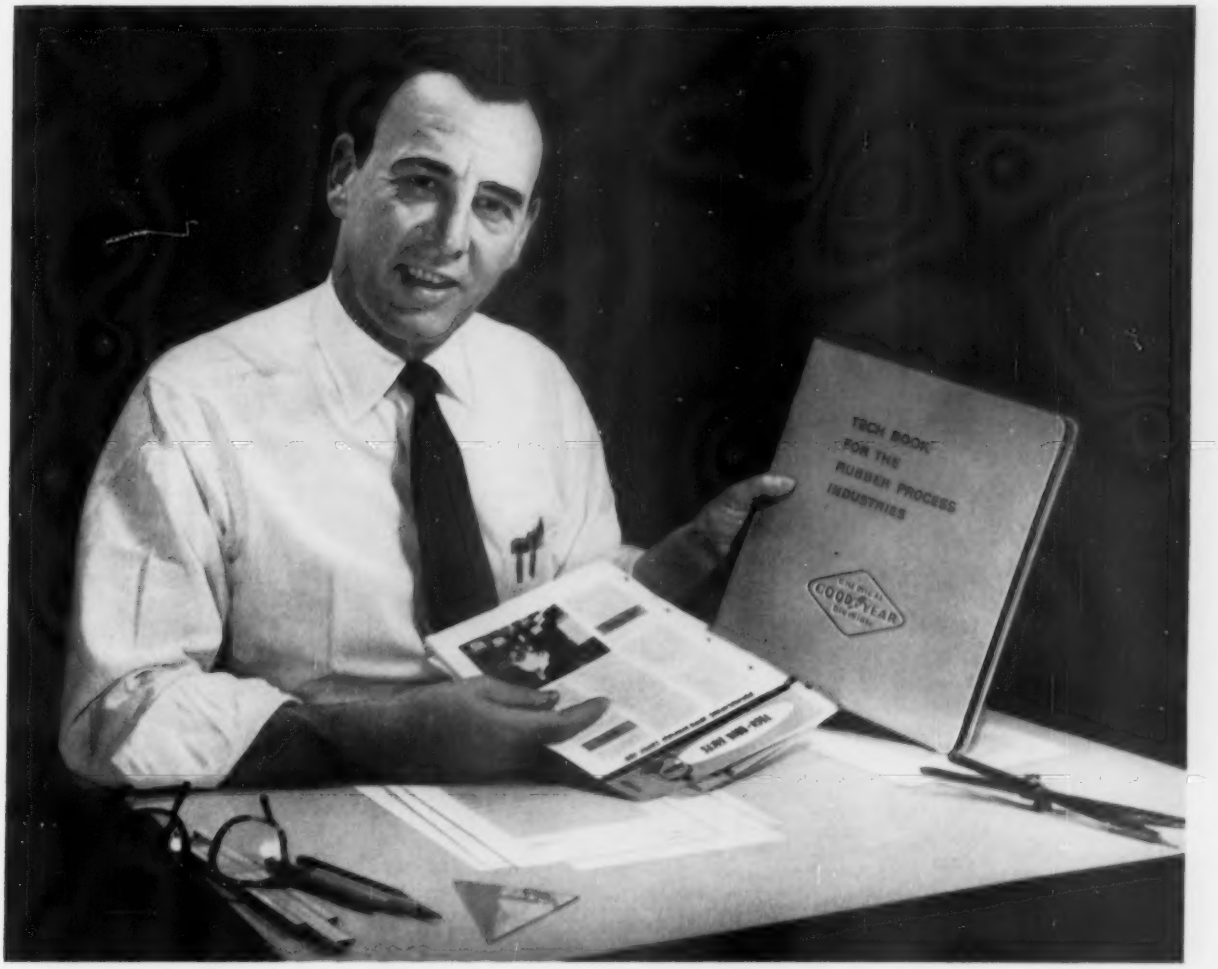

Now—A "living textbook" for the rubber industry!

Pictured above is the beginning of a new service to you from Goodyear, the leading supplier of light-colored synthetic rubbers. It's a *Tech Book for the Rubber Industry* – a compilation of technical information on raw materials manufactured by the Chemical Division for use in rubber products.

In the Tech Book, you'll find answers to such questions as: What are the physical properties of PLIOFLEX 1006? Which of the PLIOFLEX rubbers are oil-extended? How does the new CHEMIGUM N-6B differ from its sister nitrile rubbers? How do you compound CHEMIGUM N-7 to meet Specifications AMS 7274C? And you'll also find similar information on PLIOLITE S-6B – the rubber reinforcing resin – and WING-STAY S – a nonstaining antioxidant.

What's more the Tech Book, as it now stands, *is just the beginning.* It's in a convenient, loose-leaf form so that it can be kept alive and up-to-date with periodic bulletins. Write today, on company letterhead, for your *free* Tech Book and the start of the complete story on PLIOFLEX, CHEMIGUM and related products. The address: Goodyear, Chemical Division, Akron 16, Ohio.

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DIVISION

RUBBER & RUBBER CHEMICALS DEPARTMENT

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Huber's new Akron office will be staffed by Warwick McCutcheon and Larry Fuller, and will serve the area shown on the map—Ohio and eastern Michigan. The address will be:

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611 West Market Street
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Telephone: Blackstone 3-7728

A full-length article on Huber's new sales offices for the rubber industry will appear in the next issue of Huber News. If you are not on our mailing list, write us to send you a copy.

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How to Arrange Rubber Belt Drives 1006
Describing a practical method of arranging rider belts to give good service.

The Compounding of Transparent Rubber. Part II—Styrene-Butadiene, Nitrile, Butyl and Neoprene Rubbers *—By Ralph F. Wolf* 1007
The second part of a two-part article which discusses the use of fine particle size silica reinforcement pigments in the production of vulcanized rubber having both good transparency and good physical properties.

Physical Testing in the Rubber and Plastics Industries..... 1019
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*Appears every other month

Microfilm copies of complete volumes of RUBBER AGE are available from: University Microfilms, 313 North First St., Ann Arbor, Mich.
Indexed in Industrial Arts Index and Engineering Index

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Natural State	Powder
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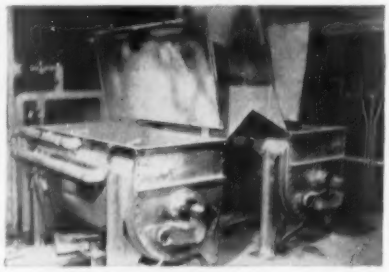

Photo shows two of many Day Blenders being used at the Goodyear Tire & Rubber Co. for mixing a variety of compounds.

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Letters to the editor

New Society Needed?

Dear Sir:

For some time past I have been of the opinion that there is a need for a society, not so much of a chemical or scientific nature, but of a practical, manufacturing type covering elastomer technology. Whereas the American Chemical Society and its Division of Rubber Chemistry undoubtedly cover a lot of ground in elastomer technology, they are primarily concerned with the scientific research end of problems, whereas what I believe is required is a society to disseminate technical and practical information pertaining to the actual use of elastomers in industry. I also believe that membership in the society I have in mind should not be contingent on scholastic standing, but should be open to anyone who is in any way whatsoever connected with the technical end of elastomer manufacture, development, distribution, etc.

In other words, what I would like to see as members in such a society is not only chemists, but also mechanical engineers, plant and department foremen and workers in elastomer industries, technical sales representatives, consultants, etc. I believe that such a society should have a journal of its own and be a national institution located in New York or Washington.

It should be built up to have different departments to take care of different problems, such as those pertaining to rubber, latex, plastics or any other elastomeric product. It also should have a legal department to answer questions of a legal or patent nature and a suppliers department to give advice where certain materials or equipment can be obtained.

It also, in due course, ought to have a reference library available. Further, there should be one department to take care of promoting and advertising the society and to take care of screening membership applications and to take care of the financial end of the society's activities.

My idea would be that each member or memberfirm agree to supply the society with technical information as long as it is not secret, so that if a member asks how some product can best be made, the society could give some advice in this respect, or refer him to specific literature pertaining to his problem. In the journal which could be quarterly and which could be subsidized by advertising of suppliers, etc., would be printed articles pertaining to new processes, methods or developments of interest to the elastomer technologist.

I think such an organization should be duly incorporated and be named either the American Elastomer Technology Society or the American Society for Elastomer Technology or the American Society of Elastomer Technologists, and

2 New Rubbers You Should Know About

New rubber No. 1 is PLIOFLEX 1500—a "cold," general purpose, nonextended butadiene/styrene copolymer.

PLIOFLEX 1500 exhibits greater abrasion resistance, higher tensile strength and higher modulus than comparable "hot" rubbers. It also displays greater tack for more ready acceptance of compounding ingredients, easier processing and better cohesion at a rubber to rubber interface.

New rubber No. 2 is PLIOFLEX 1712. It also is a cold polymerized styrene rubber, but has been extended with 37.5 parts of highly aromatic oil.

PLIOFLEX 1712 is a high viscosity, high molecular weight rubber with outstanding physical properties. Extension with oil makes it available at considerably lower cost than similar nonextended rubbers and also facilitates its processing.

Both PLIOFLEX 1500 and PLIOFLEX 1712 are protected by high potency, staining antioxidants. As a result, they are recommended for tires, Camelback and molded or extruded mechanical goods where color is not of prime importance.

Details plus the latest *Tech Book Bulletins* on these two new rubbers or the outstanding, nonstaining members of the PLIOFLEX family are yours by writing to: Goodyear, Chemical Division, Akron 16, Ohio.

Chemigum, Pliodex, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

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should cover all types of elastomers and elastomeric materials now known or yet to be discovered. I also believe that such a society should be in close contact with similar foreign societies, particularly those in England, France, Germany and Italy, possibly also those in Malaya, Indonesia and Japan.

Your comments in due course would be very much appreciated.

W. J. R. HAUSER

P. O. Box 531
Middletown, Conn.

Review and Preview

Dear Sir:

I want to congratulate you on the very fine edition of "Review and Preview". This is extremely interesting and useful information. Your 10 point forecast is optimistic and I sincerely hope that the events of 1957 will prove these points to be true.

GILBERT K. TRIMBLE

Midwest Rubber Reclaiming Co.
East St. Louis, Ill.

. . . . This is a belated "thank you" for the "1956-Review and Preview-1957". It was most impressive and informative . . . . We are glad you are doing this type of service for the industry.

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Latex Raincoats

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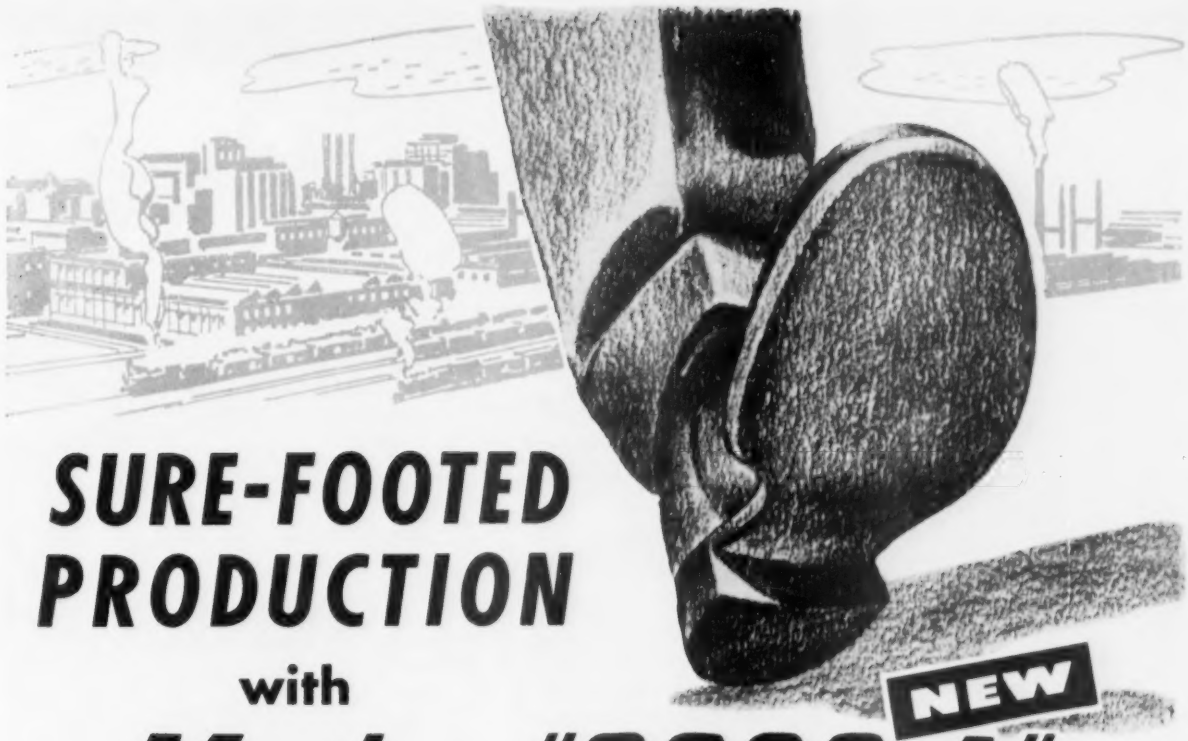
GEORGE H. NEFF, 3rd

159 Market Street,
Sunbury, Penna.

Memo from the Editor

The "Letters to the Editor" columns are open to all of our readers and we invite comments for publication. Address: Editor, RUBBER AGE, 101 West 31st St., New York 1, N. Y.



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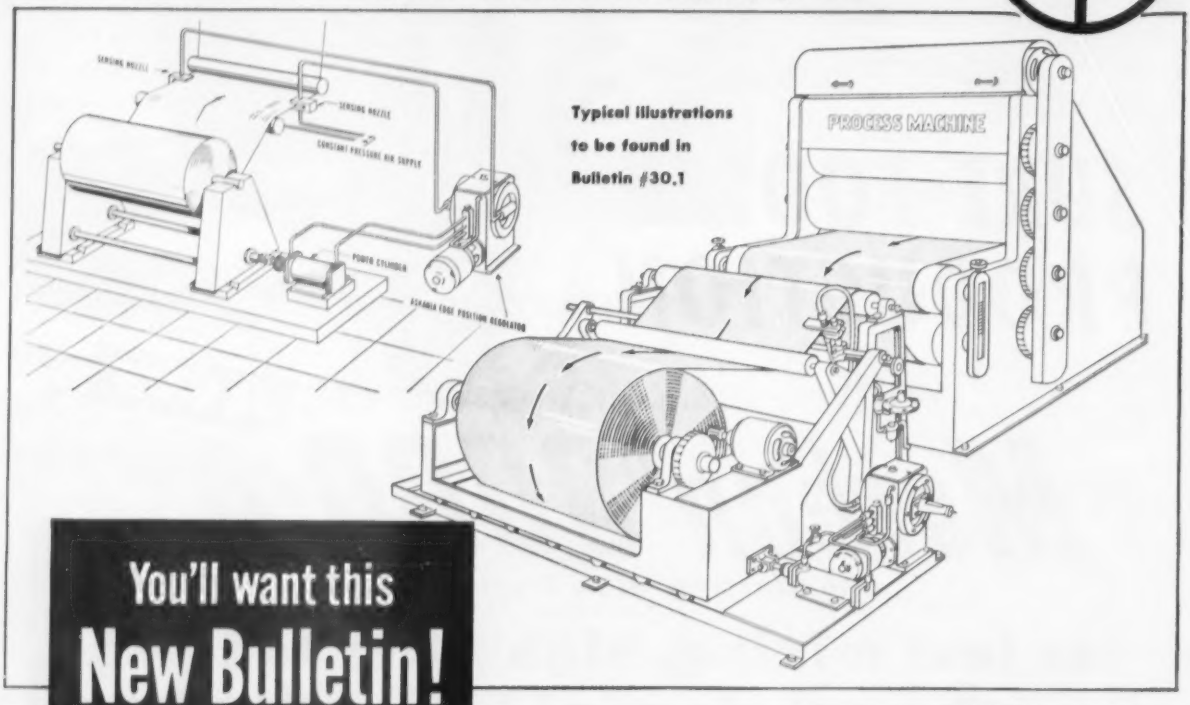

Typical illustrations to be found in Bulletin #30.1

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Tells How Calendering, Tire Lining, Rewinding And Slitting Operations Can Be Improved And Costs Lowered

ASKANIA REGULATOR APPLICATION BULLETIN #30.1 tells how economical operations, higher quality products, savings in scrap and labor can be obtained by using the ASKANIA EDGE GUIDE CONTROL.

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2 It explains the simplicity of installing these controls to new or existing equipment.

3 It tells how Askania Edge Position Controls practically eliminate trimming and minimize wastes.

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6 And it carefully describes the *exact* function of the Askania Edge Position Control —shows how and why it works as it does.

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1 Typical Edge Guide Installation on a Calender Machine

2 Guiding Raw Rubber Stock on a Conveyor Belt

3 Askania Rubber Edge Control on a Tire Liner, Rewinding Operation

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TECHNICAL BULLETINS

( ) I-17 NACCONATES . . . General Product Information
( ) I-17A NACCONATE 80 (Tolylene Diisocyanate Isomeric Mixture)
( ) I-17B NACCONATE 65 (Tolylene Diisocyanate Isomeric Mixture)
( ) I-17C NACCONATE 100 (2,4 Tolylene Diisocyanate)
( ) I-17D NACCONATE 200 (3,3'-Bitolylene 4,4'-Diisocyanate) (TODI)
( ) I-17E NACCONATE 300 (Diphenylmethane 4,4'-Diisocyanate) (MDI)
( ) I-17F NACCONATE 310 (3,3'-Dimethyldiphenylmethane 4,4'-Diisocyanate) (DMMDI)

APPLICATION DATA SHEETS

( ) 41156—Flexible Foams
( ) 7956—Semi-rigid Foams
( ) 112356—Protective Coatings

L-10

Now everybody's saving money with Dow Corning Silicones

Even the newest chemist knows about Dow Corning silicone mold lubricants . . . how they give easy release, sharper detail and finer surface finish . . . how they step up production, reduce rejects, practically eliminate mold cleaning and maintenance. But do you know all the other places where Dow Corning Silicones improve products, aid production and cut costs?

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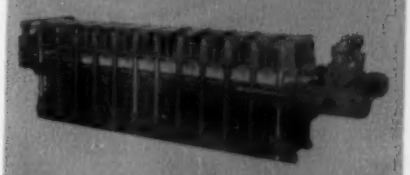
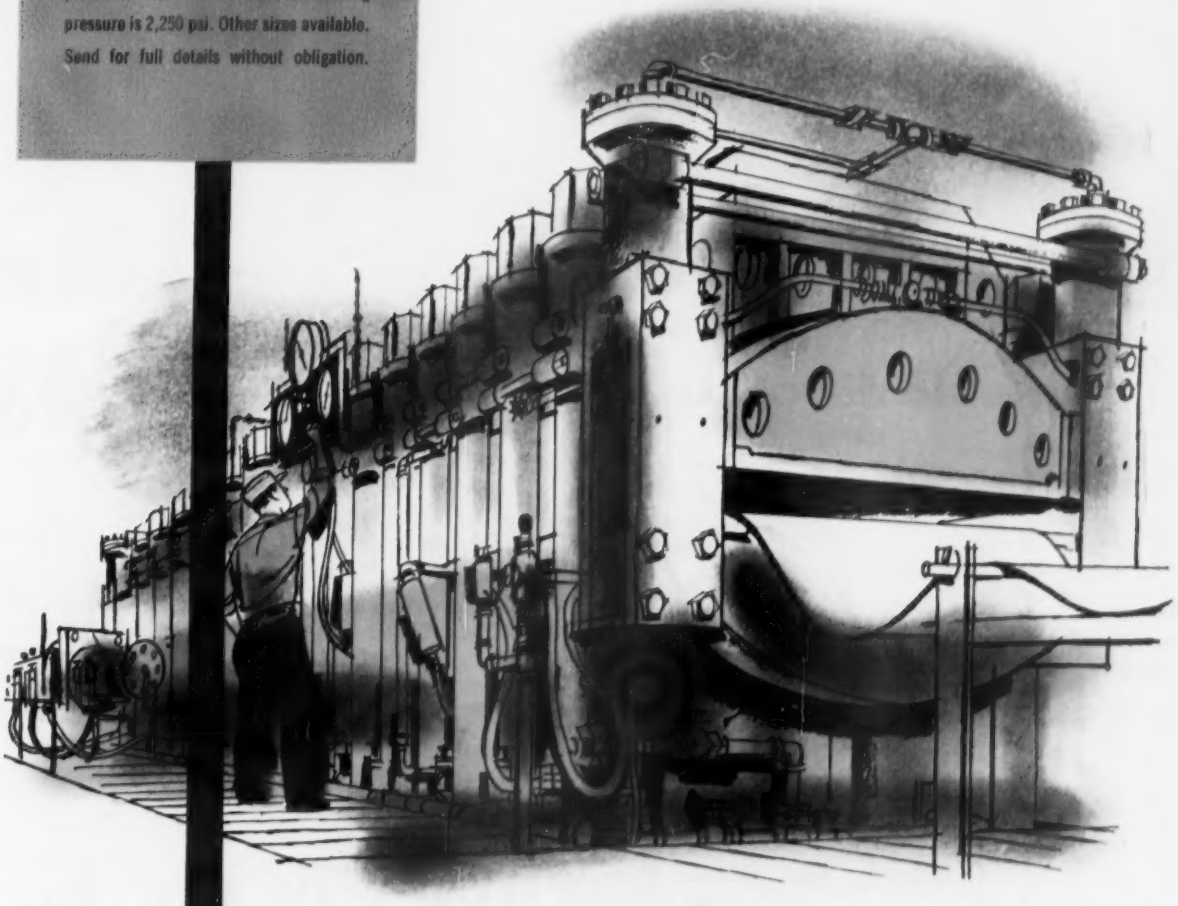
The standard by which other presses are judged



Single Opening Belt Press for vulcanizing rubber belting. Press is equipped with hydraulic stretcher and clamping units mounted at the ends of the moving platen. Press capacity is 3,180 tons. Size of heating platens is 63¼" x 30'0". Maximum working pressure is 2,250 psi. Other sizes available. Send for full details without obligation.

The proof of any press is its performance; excellence invariably shows up in service. How to be sure of quality when you choose a press? Simply look for the name 'R. D. Wood' on the nameplate. In every R. D. Wood Press, sound design, select materials, skilled craftsmanship combine to give you over-all efficiency, operating ease, production economy and long service. Write for engineering data on R. D. Wood Presses for the rubber industry.



R. D. WOOD COMPANY

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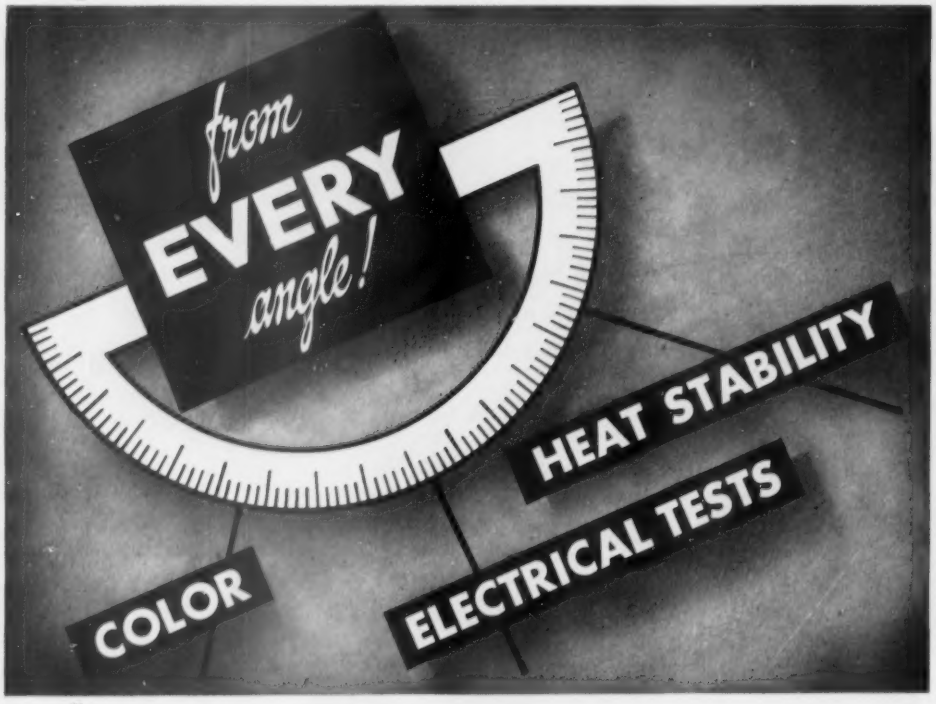

PIGMENT NO. 33

for Compounding

VINYLS AND SYNTHETIC RUBBER

Sample and technical data sent promptly on request

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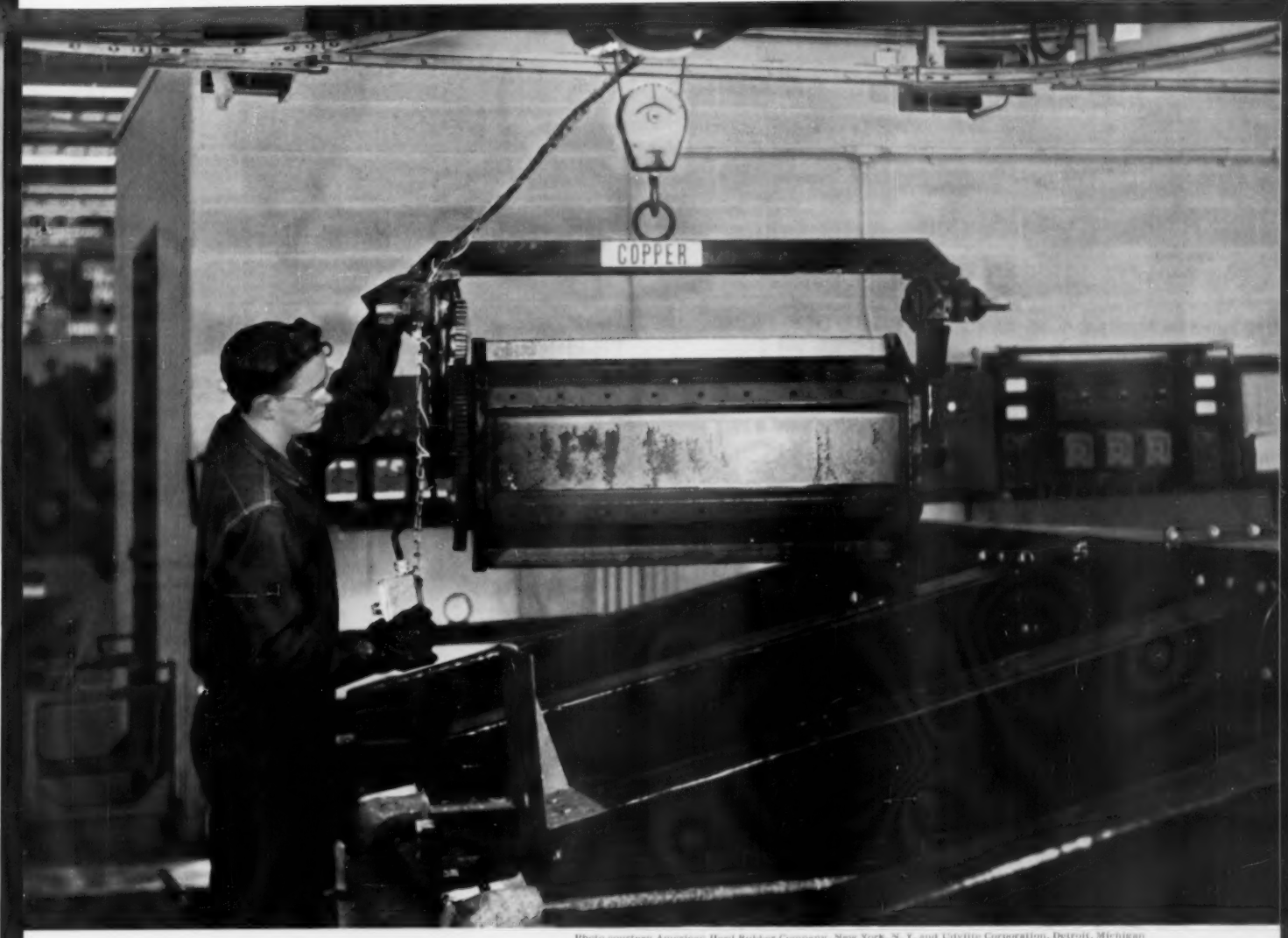

Photo courtesy American Hard Rubber Company, New York, N. Y. and Udylite Corporation, Detroit, Michigan

New Answer to a Barrel of Hot Problems

Hot problem for a leading supplier of electroplating barrels was finding the right material for the cylinders. In the face of repeated exposure to heat, hard wear and corrosive plating solutions, these cylinders had to keep rolling without contaminating the baths. After many tries, they found the answer—a new, clean-running hard rubber with three times longer life.

The major advance of this new material over its predecessors springs from the fact that it's made with CHEMIGUM nitrile rubber. Its manufacturer uses CHEMIGUM for a combination of strength plus resistance to high temperatures, chemicals and solvents never before achieved in hard rubber.

Besides better barrels for plating, CHEMIGUM as hard rubber has wide applications as pipe fittings and other equipment for handling chemicals at high temperatures. In other forms, CHEMIGUM finds use in many other products requiring unusual resistance to oils, solvents and chemicals over a wide range of temperatures.

If you have a need for an unusually versatile oil-resistant rubber of high quality, be sure you have the full story on CHEMIGUM. It's easy to get. Just write to: Goodyear, Chemical Division, Dept. C-9419, Akron 16, Ohio.

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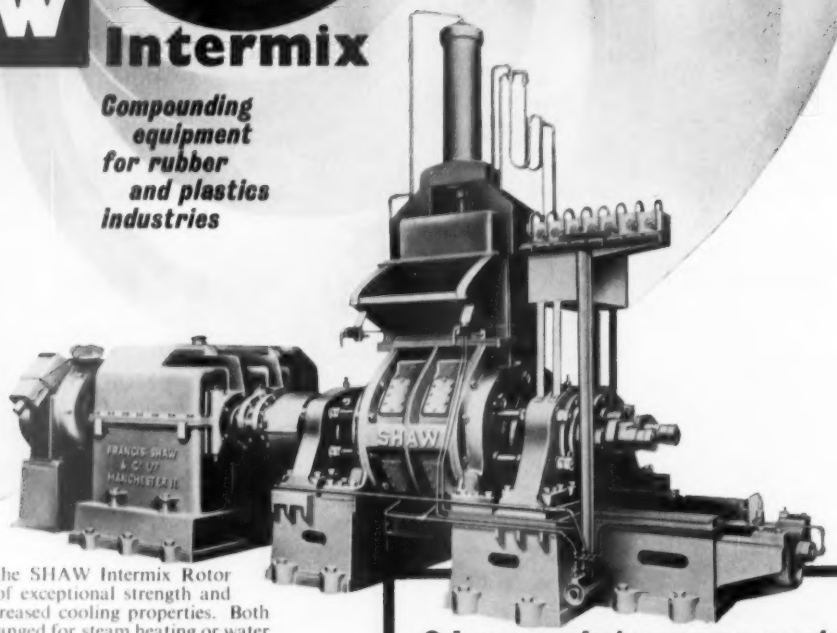
SHAW Intermix

Compounding equipment for rubber and plastics industries



The exclusive advanced design of the SHAW Intermix Rotor Assembly is not only a guarantee of exceptional strength and durability, but provides greatly increased cooling properties. Both the chamber bodies and ends are arranged for steam heating or water cooling. The rotor design avoids large masses of compound, and if desired the temperature of processed stock can be maintained at a low figure, thus a wider temperature range is obtained.

● ***This is only one outstanding feature of SHAW Intermix design; please send for fully illustrated brochure.***

Francis Shaw & Co. Limited supply a unique range of Plant for the Rubber and Plastic Industries. Enquiries are invited for Layout suggestions and arrangements.

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P4414

Another first from Monsanto

Elastopar—Puts Springy Life Into Butyl Rubber...Chemically... Without Heat Treatment

The word is out: "Butyl can go into dozens of new uses"... and, without changing your processing methods. With a boost from a new chemical modifier, butyl will find its own place among rubber products, and perhaps in completely new uses.

NEW DEVELOPMENT

Monsanto in collaboration with Esso research has developed a new product that increases the modulus and resilience of butyl rubber—*under standard processing conditions.*

This new concept in butyl modification involves a reaction of the butyl rubber with a chemical additive, N-methyl-N, 4-dinitrosomethyl aniline—trade-named by Monsanto: Elastopar. Adding Elastopar to the Banbury creates a chemical modification of the butyl polymer. You get this modification *using normal times and temperatures of mixing.*

Elastopar is effective in both black-loaded and non-black butyl rubber stocks. It is non-scorching. Elastopar actually aids processing. The modified butyl may be cured with conventional vulcanizing systems.

LOTS OF APPLICATIONS POSSIBLE

As soon as you take two pieces of stock in your hands, one modified with Elastopar, one not—you can quickly feel the improved resilience and snap.

Improved resilience is just one advantage. Here's a quick run-down on other ways Elastopar improves the properties of butyl:

- Vast increase in modulus.
- No increase in hardness.
- Raises resistance to abrasion.
- Lowers low-temp flexibility.
- Increases electrical resistivity in carbon black systems roughly from 10^6 to 10^{14}.
- Reduces cold-flow of uncured stocks.
- Lowers Mooney viscosity.
- Does not affect cure.

NEW MARKETS FOR BUTYL

One significant effect in the end-product: Elastopar checks the tendency of early experimental butyl tires to develop excessive heat from absorbed road shocks.

But of more immediate interest—the excellent solvent resistance, gas retention, and high dielectric properties of butyl can be put to use in cable coating, automotive "air springs," gaskets, and mechanical goods. For more information on how Elastopar can help you build-in new profit-making properties in butyl, call or write today.

Accelerators—*For fast, slow, and regulated rates of safe cure.*

Antioxidants—*For maximum oxidation resistance.*

Plasticizers

Specialty Processing Compounds

You can *feel* the difference instantly—but watch! Stock at right, unmodified butyl. At left, modified with Elastopar. See what happens.

Sample modified by Elastopar, left, flattened completely in 3 seconds. This new resiliency is just one of nine valuable properties butyl rubber offers when *chemically* modified with Elastopar.

ELASTOPAR: Reg. U. S. Pat. Off.

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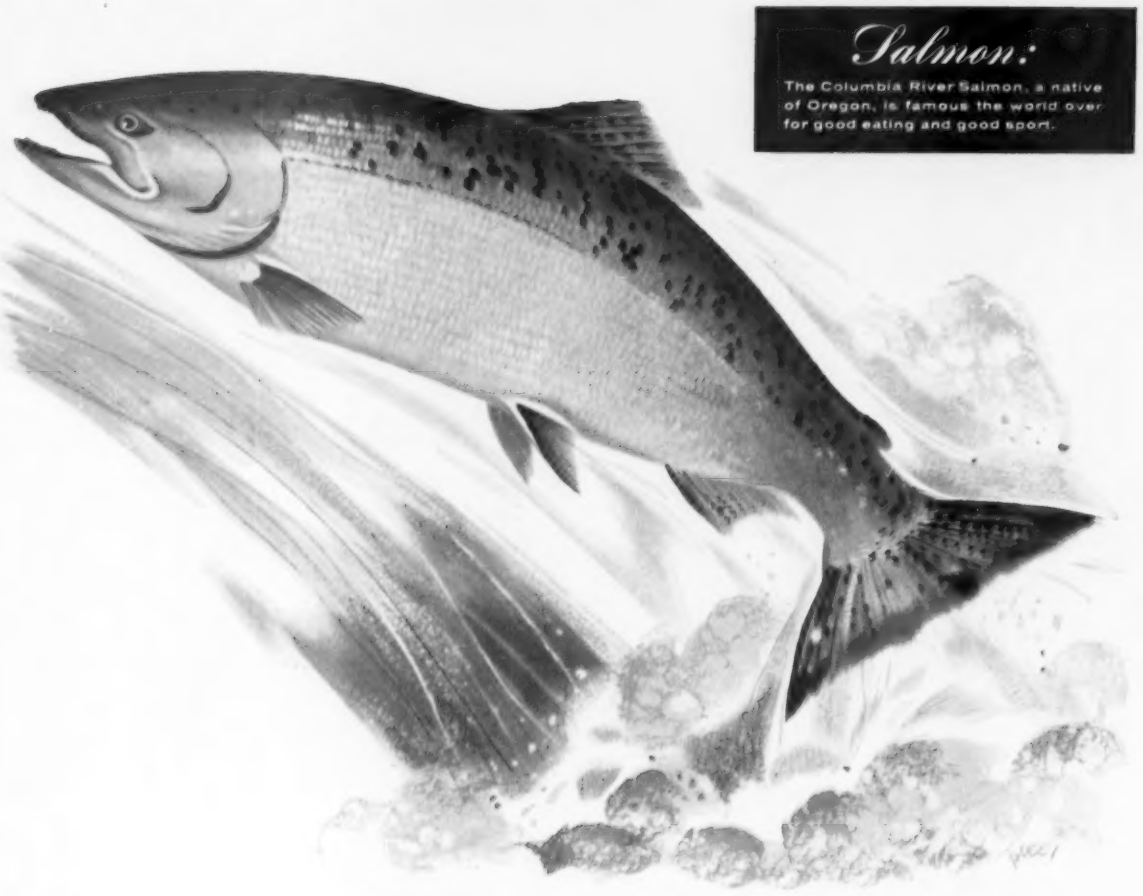
Rubber Chemicals Dept.
Telephone: HEmlock 4-1921, Akron 11, Ohio



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Synthetic Rubber Sales Division
P. O. Box 216, Torrance, California

SHELL

Capitol Cues

THERE WILL BE SOMEWHAT LESS INFLATION this year than during 1956, in the opinion of the government's top economists. Experts from industry agree with this size-up, too. They do not mean that the present brisk uptrend in prices and wages will soon stop. But gains should be smaller.

The big reason for the forecast is the feeling that business activity won't be speeding up as much as it did in 1956. So demand won't rise as much. At the same time, supply of most goods will be bigger as new plants start producing. No big strikes or foreign crises are likely to upset things, either.

LOOKING AT INDUSTRY'S LABOR COSTS, they won't climb quite as much as last year, if you consider wages, fringe costs, and productivity altogether.

- Wages, for one thing, will go up slightly less than the 10¢ an hour average for last year. Long-term agreements containing deferred-increase provisions assure part of this; escalator clauses will provide some more gains as consumer prices rise.
- Fringe costs, however, won't rise as much as in '56. The big pace-maker unions won't be bargaining—breaking new ground.
- Productivity will go up much faster than in 1956, which was a disappointing year. Industry will get more for its money.

Reduced profit margins will make industry a tougher bargainer.

THE FORECAST FOR PRICES IN 1957 is even more hopeful. Most government price experts see only about half the sizable gains that occurred last year. The slow-up will reflect the labor cost developments, plus better supplies.

Here's what the price specialists are forecasting:

- Machinery and other producers' equipment, which shot up 13% in the past year and a half, will cost only 4% or 5% more.
- Materials—components, too—are expected to inch up another 2% or 3% this year. Rise was 8% over the past 18 months.
- Building materials are leveling off. Steel and cement may zoom but, over-all, hikes will be only half last year's 4%.
- Consumer prices will move up 2% this year, as compared with 3% in '56. Practically all items will show the higher tags.

DOUBTS ABOUT BUSINESS PROSPECTS later in '57 have begun to show up. They're still scattered—not truly representative of most business thinking. Indeed, the pessimism looks like a seasonal thing—a first-quarter letdown. Talk like this cropped up last year at this time, and turned out unfounded. Nevertheless, the point of view is worth examining—and watching.

Behind the doubts, you hear this sort of talk:

- Auto sales—a big part of manufacturing—won't meet targets.
- Plans to expand plant have been reduced by some companies.
- Steel orders have slowed down a bit, and could cut output.
- Housing starts are slipping from 1956's relatively low total.
- Stock prices have been drifting down, reflecting uneasiness.

Checks with leading government and business economists reaffirm the opposite view: Business will be good the rest of the year. This doesn't mean there couldn't be a leveling out in the final months. But that's as bearish as most of the experts will get.

Continued on Next Page

EISENHOWER'S POLICY IN A RECESSION—if and when one does develop—would be vigorous and even New Dealish. Members of his team are emphatic on this, despite those recent anti-spending remarks of Treasury Secretary George Humphrey. You may recall that Humphrey said flatly that he'd oppose a return to deficits under any conditions. And he's been Ike's key adviser.

> Humphrey feels that deficits can not cure an economy's ills. They may make things worse. But the President has been turning to other advisers lately. These men believe that the important thing in a downturn is to keep income up and people spending, so that huge debts don't go into default. And this is the view that is going to prevail—as long as Eisenhower holds office.

THE NEXT BUDGET WILL BE EVEN BIGGER than the one Eisenhower sent up to Congress in January. Only an end to the Cold War could head this off. Budget officials already see where the increases are coming from: Military procurement, as guided-missile production goes up...construction of schools, roads, etc...and expanded health, veterans, and social security programs.

> It looks now as if the Budget for fiscal 1959 will provide for spending of $75 billion. The Budget for fiscal 1958—now being debated in Congress—calls for spending of only $72 billion.

SLIGHT TAX RELIEF FOR SMALL BUSINESS may yet be voted by the Congress this year. It wouldn't cost the Treasury very much in revenue—that's why prospects are so good. But for many firms the changes would be important. (Chances of a cut in the income taxes of small companies are still poor.)

> Leading Congressmen on the tax committees are disposed toward permitting heirs to pay estate taxes over 10 years—instead of having to liquidate a going business. Also, they would permit investors who put money into small firms to deduct the losses; thus, the small companies would find it easier to raise capital.

A CUT IN PAPERWORK REQUIRED OF BUSINESS will probably be ordered by Congress this year. The Treasury wants to consolidate two separate forms—(1) the quarterly reports on social security, and (2) a form listing income-tax withholdings. The new combined form would be due only once every year. The new system could take effect next January...saving $20 million annually.

TAX TIPS FOR SMALL BUSINESS are listed by Internal Revenue Service in a new, 128-page guide just out. It was prepared to help proprietorships, partnerships, and small corporations with income, excise, and payroll taxes. The book deals with tax consequences of organizing as a partnership instead of a corporation...buying a concern...dissolving one...and daily operations.

> The Internal Revenue book also includes a tax calendar, showing when taxes are due. You can get "Tax Guide for Small Business" for 30¢ from the Government Printing Office, Washington 25, D.C.

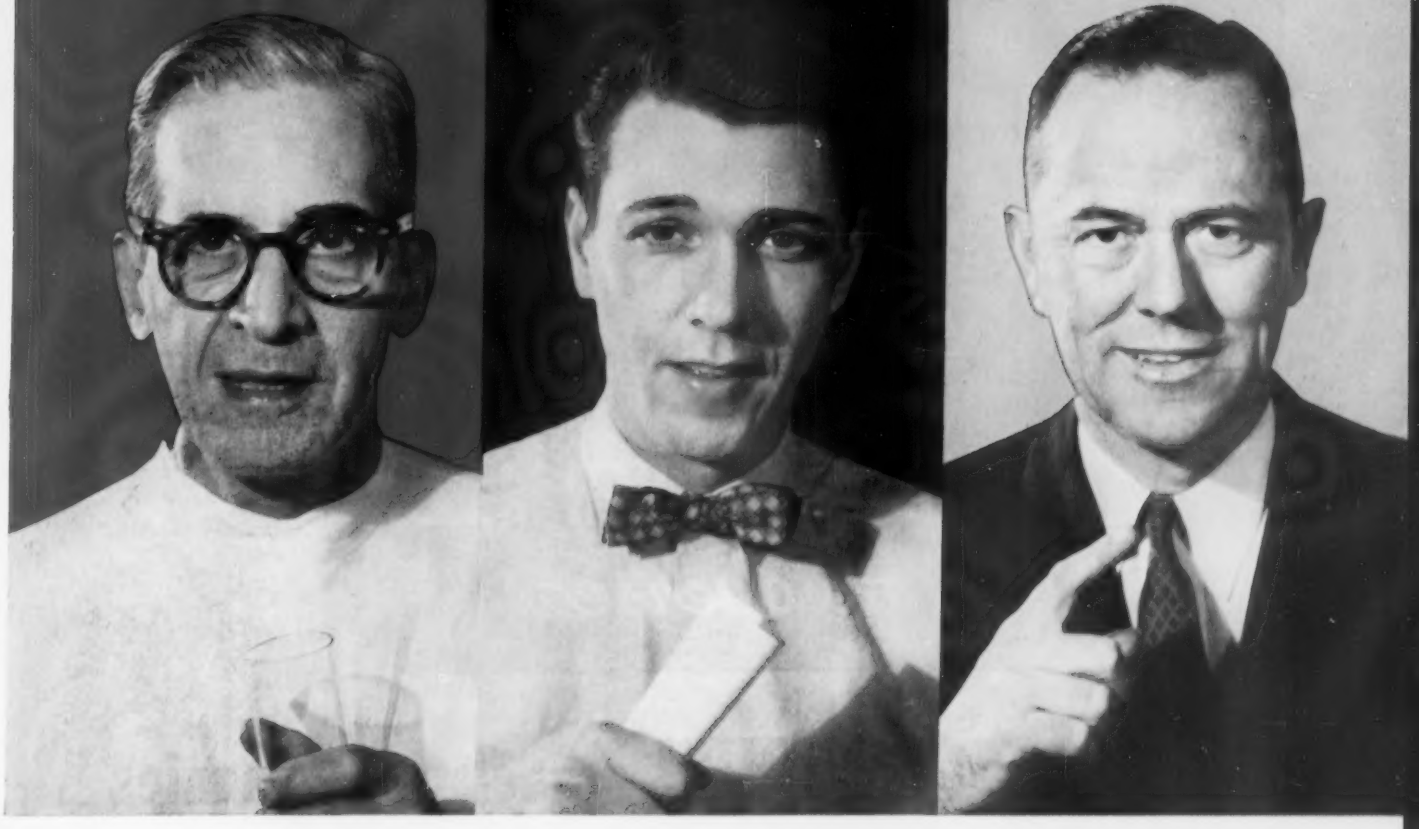
CANADA'S BOOM IS STILL ROLLING. Its business will rise relatively faster than in the U.S. Total activity—up 11% in 1956—will gain 8-10% this year, twice what's expected here. Expansion of plant will be up 15%... exports, 10% to 12%...imports, 15%...and prices, up about 3%.

"BLACKS?"

"TOP QUALITY" says the Lab

"CONSISTENT RESULTS" says Production

"SERVICE AND ECONOMY" says Purchasing



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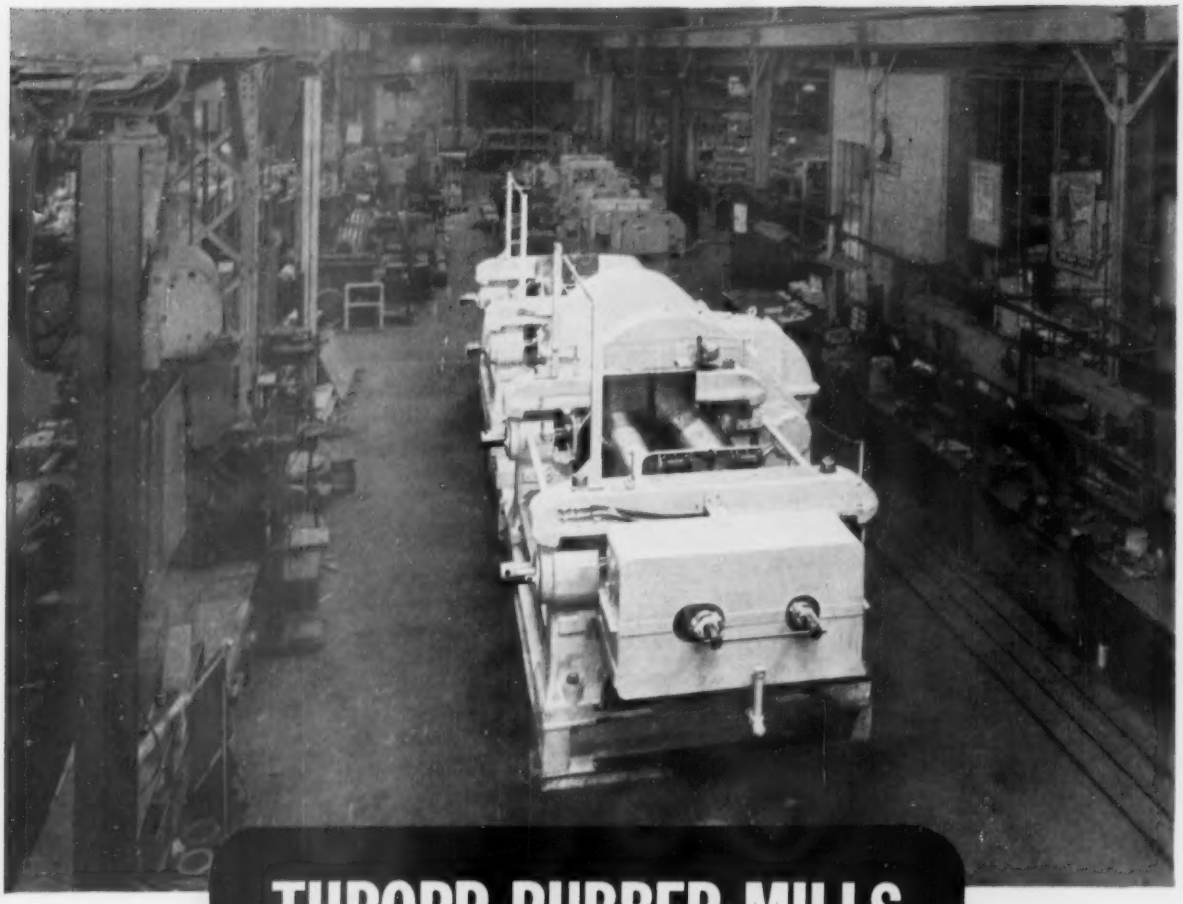

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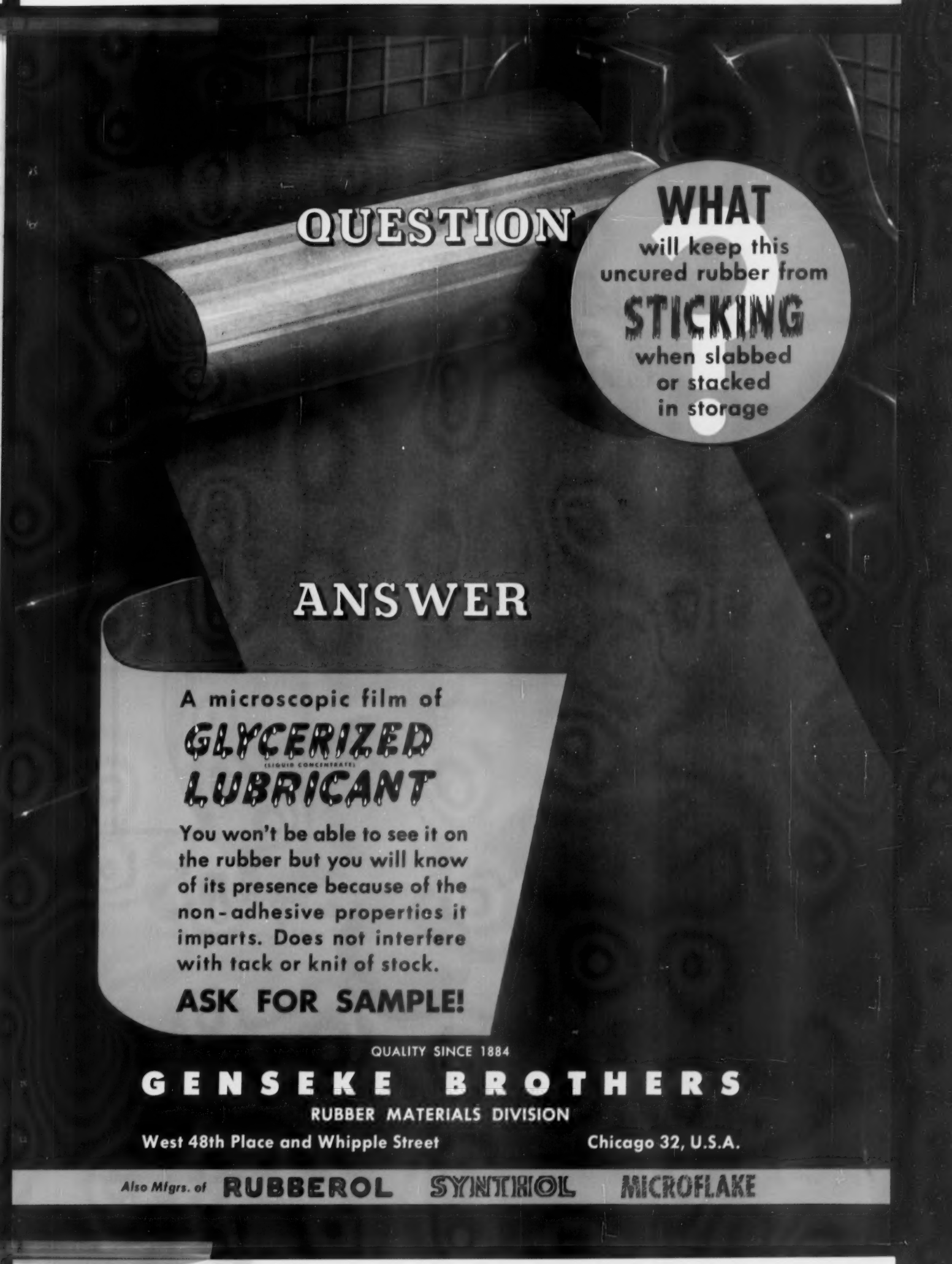
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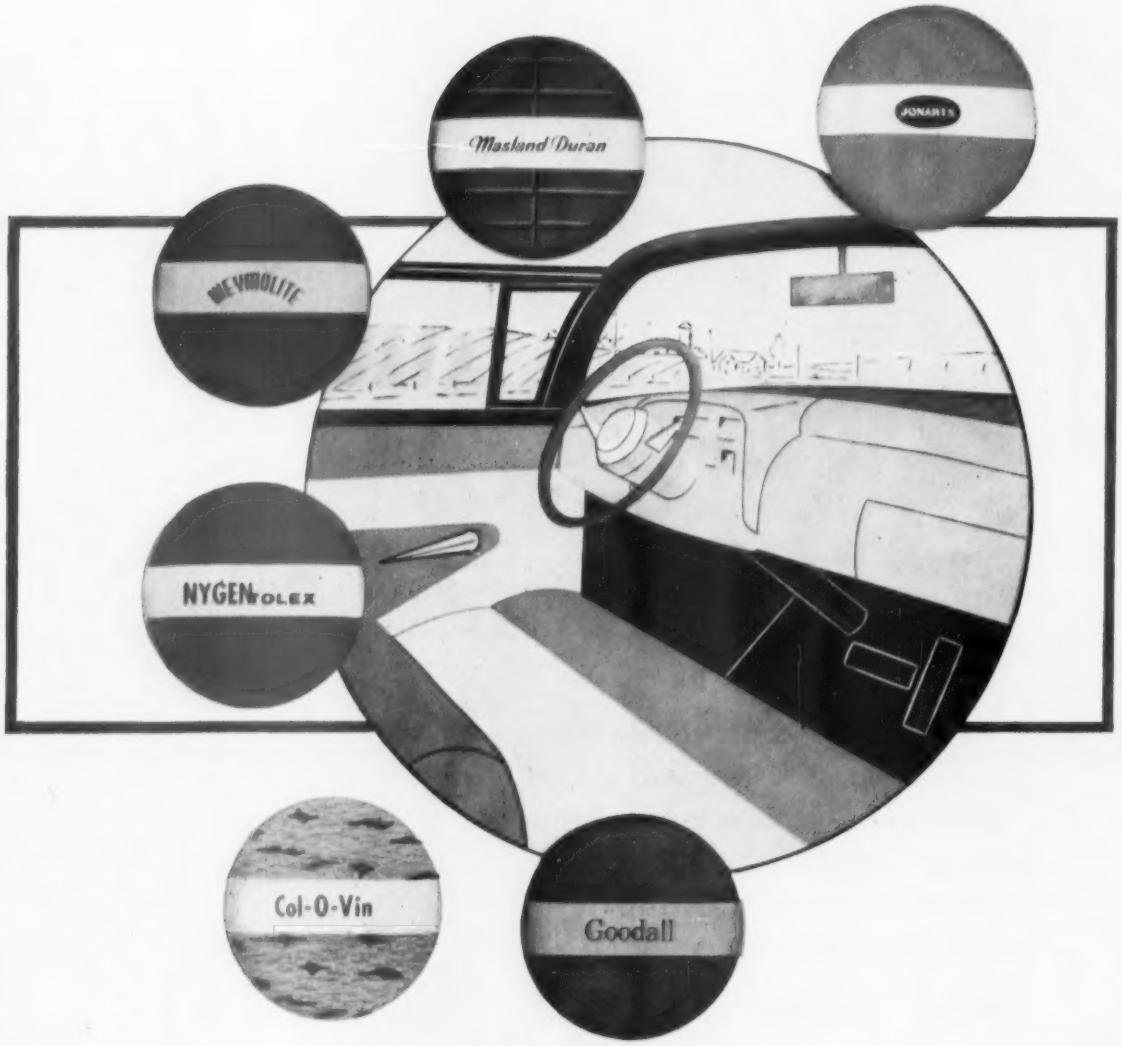

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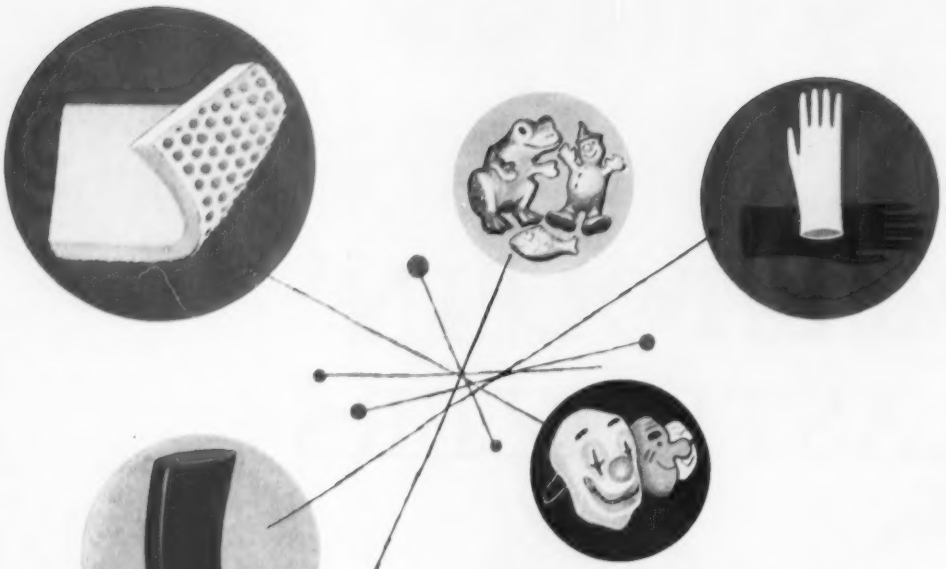

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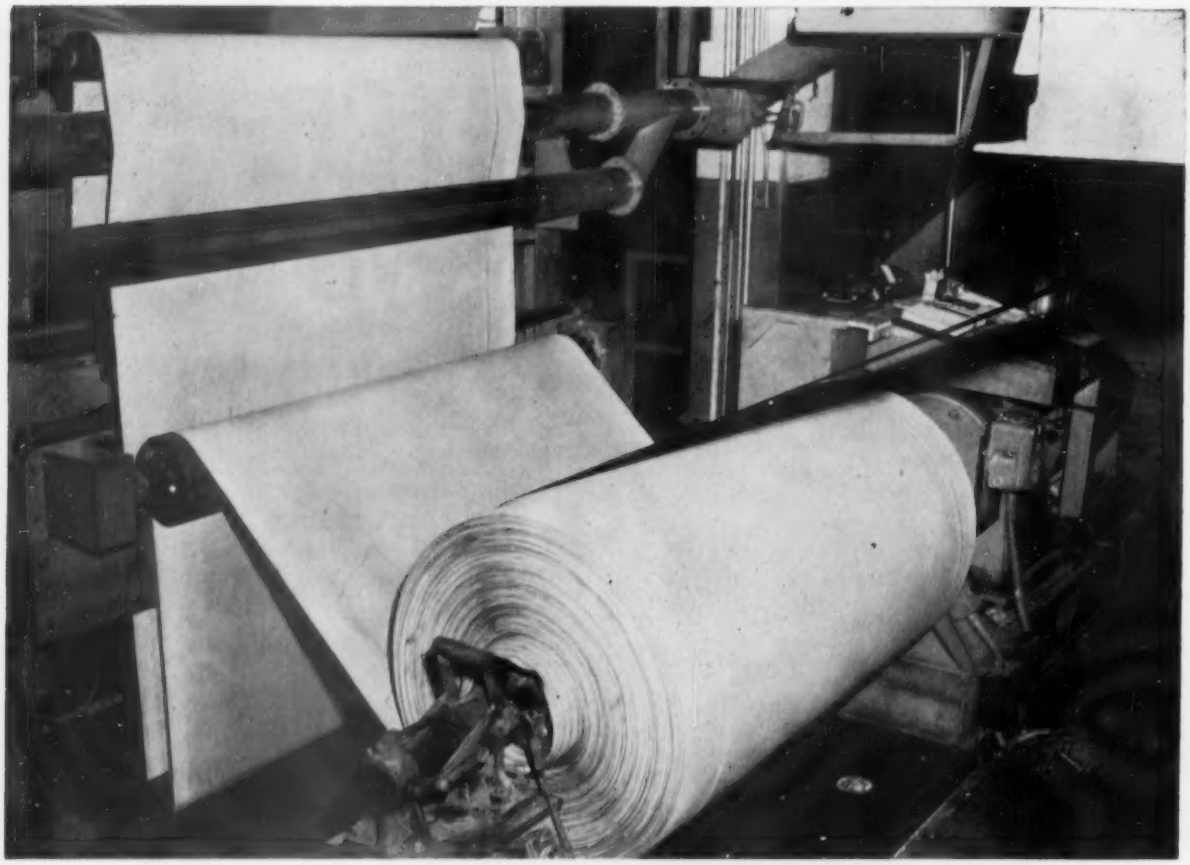

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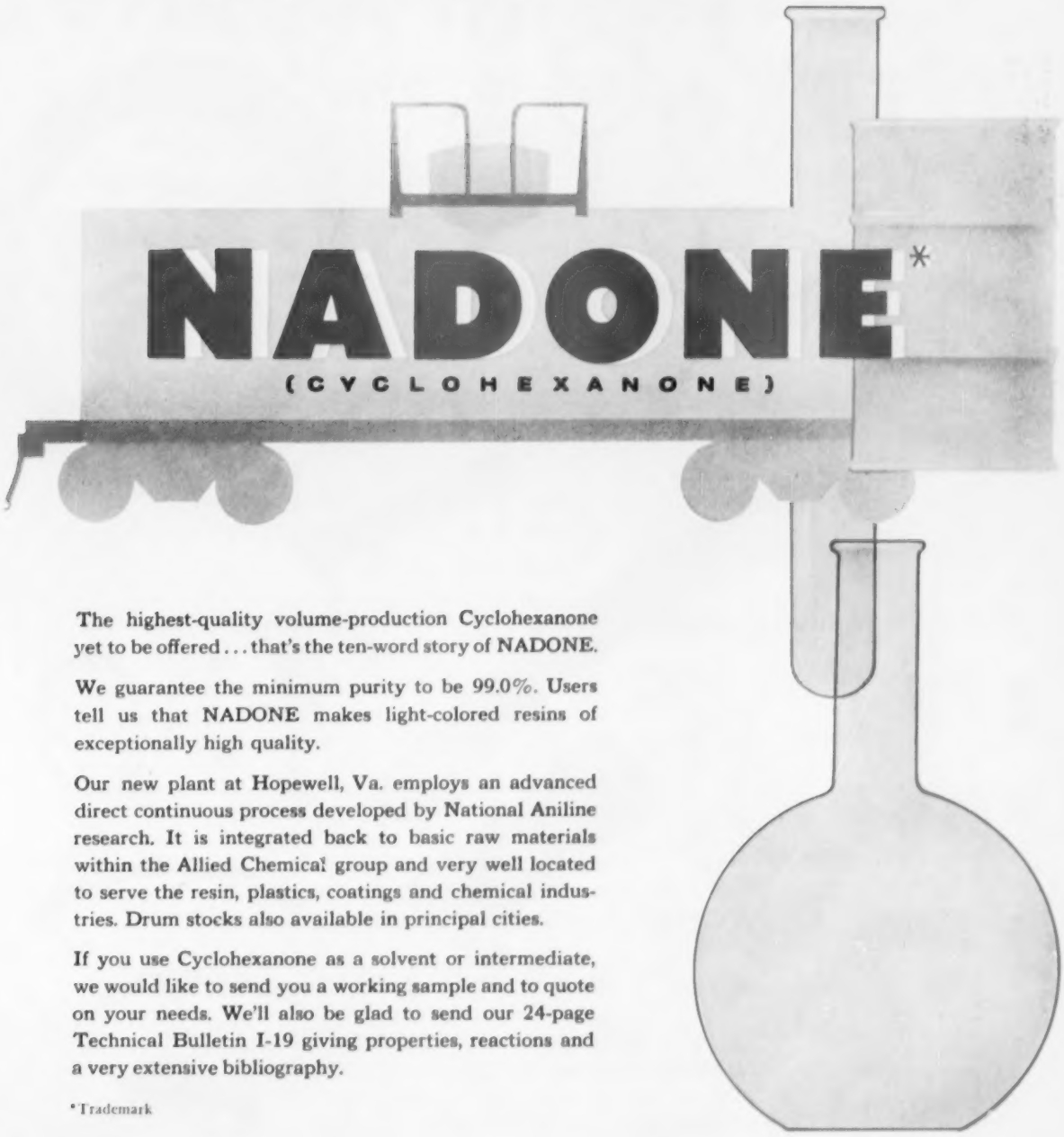

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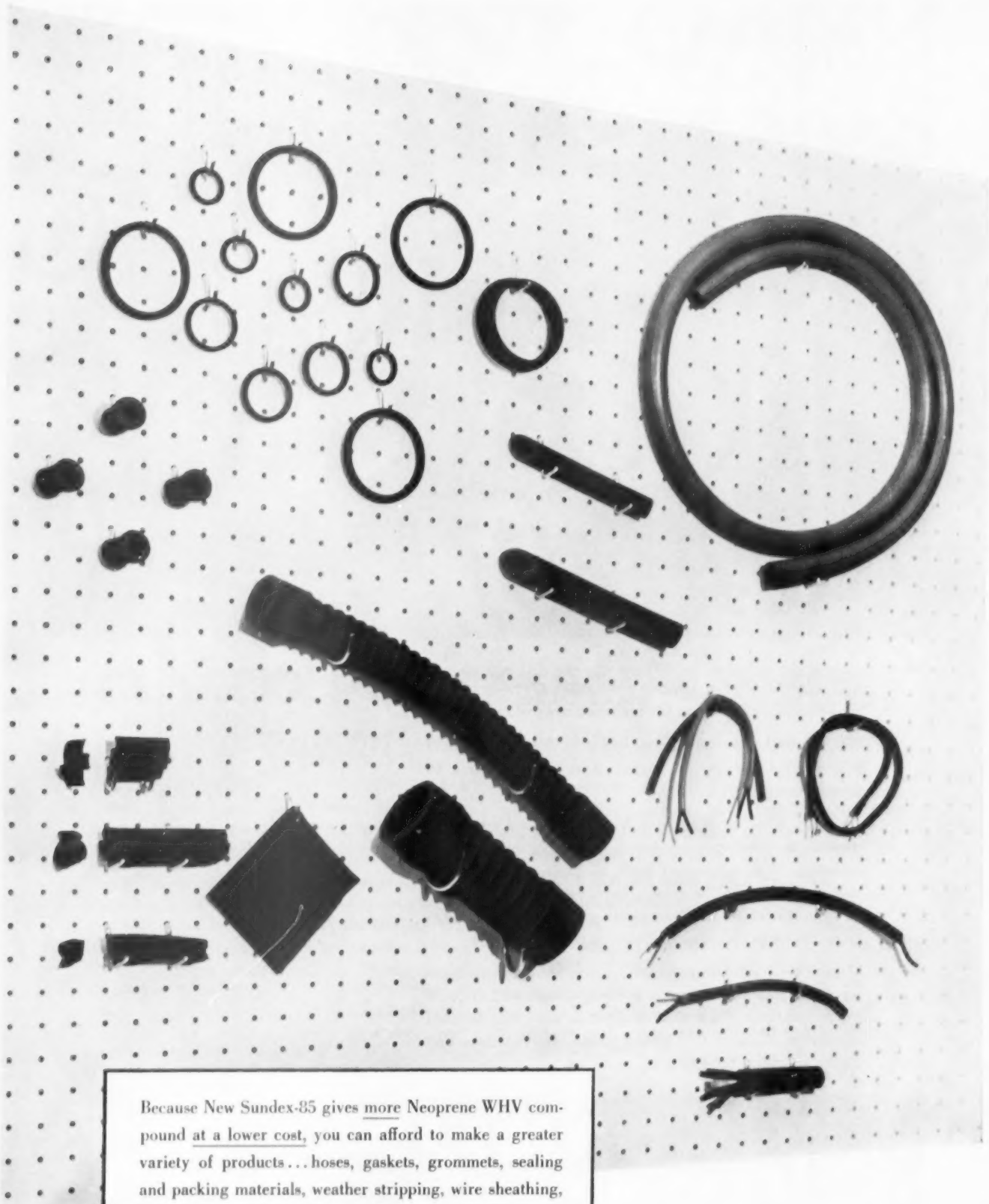

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By using high loadings of new Sundex®-85, you can lower the cost of your Neoprene WHV compound and still retain the properties that make neoprene outstanding for oil-resistant mechanical goods.

As much as 100 parts of Sundex-85 to 100 parts of neoprene hydrocarbon have been used successfully. Sundex-85 also conditions the compound for easy handling during processing.

Even with unusually high loadings of Sundex-85, neoprene products maintain their high resistance to oil, grease, ozone, heat, and sunlight. It helps assure quality in oil-resistant automotive and industrial hose, sealing and packing materials, gaskets, grommets, and other molded goods where cost is a strong factor.

Sundex-85 is compatible with neoprenes, natural rubber, butadiene-styrene type, and acrylonitrile polymers. Here are some of its typical properties:

Viscosity, SUS at 210F	90
Specific gravity at 60F	1.017
Refractive index, n_D^{20}	1.5869
Aniline point, deg F	90
Color	Dark

FOR COMPLETE INFORMATION about Sundex-85, ask your Sun representative, or write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. RA-3.

SUNOCO®

© Sun Oil Company

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY PHILADELPHIA 3, PA.

IN CANADA: Sun Oil Company Limited, Toronto and Montreal • IN BRITAIN: British Sun Oil Company Ltd., London W.C.2, England • THE NETHERLANDS: Netherlands Sun Oil Company, Rotterdam C, The Netherlands • WESTERN EUROPE (except the Netherlands), NEAR EAST, NORTH AFRICA: Sun Oil Company (Belgium) S.A., Antwerp, Belgium.

SUPPLIERS—

Blanket the $6 Billion rubber market for the next two years with this directory!

The 1957-58 RUBBER RED BOOK, 11th Edition of the industry's only directory, will be published in June, 1957, and will last until 1959. Copies will be sent to the key men—*the buying influences*—in 1600 rubber goods plants in the United States and Canada.

USED DAILY

Over 1200 pages of vital information, available in no other single source, make the RUBBER RED BOOK the most widely used reference book in the field. Technologists, purchasing agents, plant management—all use this directory to solve daily problems. That's why well-thumbed copies are on the desks of those who buy . . . specify . . . select . . . influence.

ECONOMICAL

Your advertisement will last for two years, serving as a constant reminder of your products . . . materials . . . equipment . . . services, long after your salesman has left the customer. It will be available for study at the exact moment when buying decisions are being made, reaching those people who influence purchases but whom your salesmen can't reach.

READERS SAY—

"our most useful and most used book on rubber" . . . "practically indispensable, finds constant use" . . . "the most complete reference book on rubber ever seen" . . . "an invaluable service to the industry"

Closing date: April 15, 1957
Publication: June 1957

ORDER SPACE NOW

400 of the field's top suppliers used space (323 pages) in the last issue, one using 20 pages. Others used separate ads on as many as 8 to 10 different products. With those who know the field, RUBBER RED BOOK advertising is a must. Arrange now to be in the 1957-58 issue with enough space to tell your full story. Send in your order today.

•

Published by the rubber industry's leading technical journal, first in advertising and editorial pages, and the only A.B.C. journal in the field.
Use RUBBER AGE monthly and RUBBER RED BOOK bienially for the most powerful sales combination possible to cover this market.

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Condensed Schedule of Rates for 1957-58 Edition

1 page	$200;	2 pages, each	$195
½ page	110;	2-½ pages, each	107
¼ page	65;	2-¼ pages, each	63
Colors: Red	75;	Other colors	100
Bleed pages			extra 25%

Sales Agents Section:
In addition to standard ¼, ½ and full page units, there is available only in the Sales Agents and Branch Offices Section, a one inch unit @ $38.

For complete rates and sizes write for 1957-58 rate card.

RUBBER AGE

101 West 31st Street, New York 1, New York

Phone: PEnnsylvania 6-6872

233

BEST IN TRANSPARENT RUBBER, TOO

HI-SIL®

Interest has increased greatly during recent months in transparent rubber stocks for "crepe" soling and other specialty molded goods.

Columbia-Southern anticipated this interest years ago and set up an extensive research project in the transparent rubber field. The results are now published (*Rubber Age*, February 1957) and will soon be reprinted in our technical bulletin series. If you are not on our regular mailing list, you may reserve a copy by addressing Room 1929A at Pittsburgh or any of our district sales offices.

Tests indicate Hi-Sil 233 to be the best available reinforcing pigment for transparent applications. Commercial stocks with an excellent level of physicals can be produced as transparent compounds with this specific reinforcing silica.

Loadings as high as 97.5 parts (50 volumes) still give excellent transparency in PLIOFLEX* 1778, a new oil-extended polymer. This stock will whiten when flexed, but aptly demonstrates the limits that can be reached. Reducing the pigment loading in PLIOFLEX 1778 to 40 volumes (78 parts) results in a useful compound of middle 80 Durometer hardness. At lower loading levels, other GR-S types are suitable.

A serious investigation of color in transparent compounds was beyond the scope of this work. However, preliminary efforts showed that production of colored stocks is completely practical.

Technologists and others who may be intrigued by transparent rubber possibilities are invited to contact us today for more information.

*PLIOFLEX—TM, The Goodyear Tire & Rubber Co.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION

SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY

ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DISTRICT OFFICES: Cincinnati • Charlotte • Chicago • Cleveland
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IN CANADA: Standard Chemical Limited and its Commercial Chemicals Division

ONLY Allis-Chalmers

ALLIS-

MOTORS are "double protected"

New Integrated Field Coils Plus *Silco-Flex* Stator Insulation Provide Superior Motor Protection... Under Any Operating Conditions

1

Integrated Field Coils are bonded in heat-stabilized resins, enclosed in a resin-impregnated sheath of oriented glass fibers and bond-locked on the pole structure . . . dimensionally stable to withstand heating and thermal shock, vibration and fatigue at elevated temperatures . . . sealed throughout against atmospheric contaminants and fully protected against destructive forces.

2

***Silco-Flex* Insulation** provides a homogeneous, void-free insulating wall of silicone rubber on stator coils. It is unexcelled in life and thermal stability at high temperatures . . . resistant to most chemicals, water, weather . . . outstanding in flexibility and resilience . . . able to withstand abrasion and corona . . . resistant to physical and mechanical forces.

Exclusive Allis-Chalmers "double protection" is available on large electrical machines with operating temperatures through Class B range.

Silco-Flex is an Allis-Chalmers trademark.

For more information on these quality insulation systems contact your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin for Integrated Field Coil Bulletin 05R8525 and *Silco-Flex* Insulation Bulletin 05R8341.

Allis-Chalmers "Double Protection," with integrated field coils and Silco-Flex stator coil insulation, adapts this 600-hp, 2300-volt, 600-rpm synchronous motor to the most severe operating conditions.

CHALMERS

A-C ALLIS-CHALMERS

A 5221

Naugatuck POLYGARD

in non-staining SBR* type polymers

First, POLYGARD® provides protection against resinification from heat during the production and storage of the raw polymer.
Second, POLYGARD provides protection against heat and oxygen degradation during the manufacturing processing step in fabrication and thus minimizes harmful gel increase and viscosity changes.

Third, POLYGARD protection thus obtained assures freedom from discoloration plus optimum quality and service life in the finished vulcanized products.

Added Advantages:

1. POLYGARD is a liquid which disperses easily and uniformly.
2. POLYGARD polymers do not contact-stain lacquers, plastics or fabrics.
3. POLYGARD does not contribute taste or odor to polymers.

For samples, compounding information, and technical data, why not write us on your company letterhead today?

Naugatuck Chemical

Division of United States Rubber Company
Naugatuck, Connecticut

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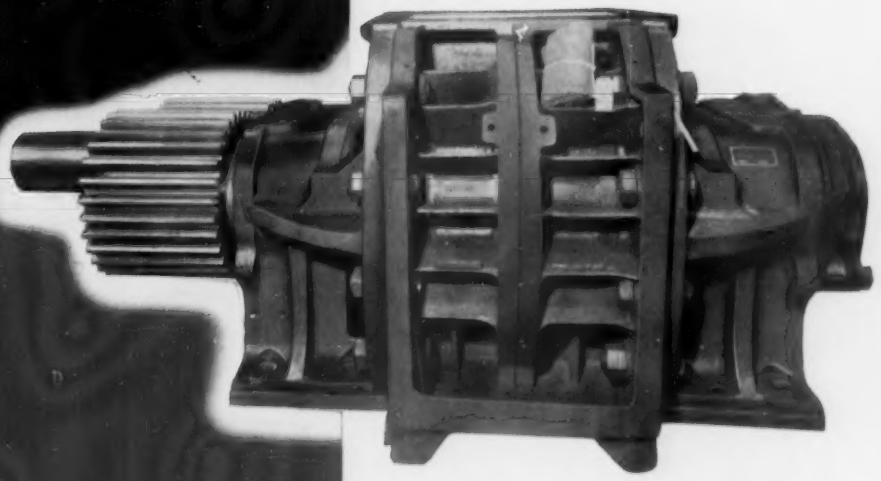
*Styrene Butadiene Rubber

A SECO REBUILT BANBURY

ESTABLISHED 1868



guarantees new equipment performance

A SECO rebuilt Banbury is backed by Skinner Engine Company's 89-year history of high-precision machining in the heavy goods industry—your guaranty of the finest of engineering and workmanship.

Rotors, side jackets, rings, bearings, end frames, thrust nuts, door tops, connecting gears—all are carefully examined by skilled technicians and magnafluxed to detect hidden defects. Each worn part is either replaced by a new part or is restored to its original size and contour. All wearing surfaces are thoroughly hard surfaced.

When your Banbury mixer needs repairing or rebuilding, give us a call—one of our engineers will visit your plant and inspect your installation—without cost or obligation to you.

INTERCHANGE PLAN: **For a minimum of down time, investigate our guaranteed interchange plan.**

STOCK PARTS: **Large inventory, available for immediate shipment.**

SKINNER · ENGINE · COMPANY

SECO

RUBBER MACHINERY DIVISION
TELEPHONE ERIE 2-3661
ERIE 6 · PENNSYLVANIA

Paying out hose at 50 mph, thanks to Fortisan-36 rayon

The Impossible took a little longer

It only existed in specifications.

The U. S. Army wanted a fuel hose with 4″ inside diameter and burst pressure of 500 PSI; so flexible and light it could be payed out of a truck or helicopter at 50 miles an hour.

It only existed on paper. Now it is fact—with Fortisan-36. Using this new Celanese fiber as reinforcing yarn, U. S. Rubber—and the U. S. Army—solved a seemingly impossible problem at low cost. Fortisan-36 has tremendous tensile strength (twice that of viscose rayon, for example) at light weight. Practically speaking, it doesn't stretch under pressure. Nor do temperature and moisture changes affect its dimensions. It is a remarkable fiber and it makes remarkable hoses. V-belts, conveyer belts, tarpaulins, too.

Remember—Celanese not only delivers its fibers, but its technical skills as well. Let us put Fortisan-36 on the job—together. Celanese Corporation of America, Industrial Sales Department, Textile Division, Charlotte, North Carolina. Celanese®

Branch Offices:

180 Madison Ave., New York 16, N. Y.

22 W. Madison St., Chicago 2, Ill.

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Amcel Co., Inc. and Pan Amcel Co., Inc. — 180 Madison Ave., New York 16, N. Y.

In Canada:

Chemcel, Canadian Chemical & Cellulose Co., Ltd. — 2035 Guy St., Montreal

Celanese

Fibers for Industry

FORTISAN® RAYON • FORTISAN®-36 RAYON • ARNEL® TRIACETATE • ACETATE • VISCOSE-RAYON

Here's news!

Baker CALCIUM NITRATE, Tech.
ZINC NITRATE, Tech.

in THIN FLAT FLAKES

- *Faster dissolving*
- *Uniform purity—lot after lot*
- *Controlled water of hydration*
- *Easier to handle*

Look over the photograph above, reproduced to actual size. Note the thin flakes with large surface area. THIN FLAKES go into solution FAST – you save time and money. They are easy to handle. These chemicals in *flake* form represent another Baker first.

Latex processors gain better control of coagulation because of the controlled high assay and known water of hydration. This uniform purity, controlled pH and freedom from extraneous matter insure better quality in your finished goods with fewer rejects.

These chemicals are produced to meet precise specifications. In the informative typical analysis shown below, note the very low ammonium nitrate content in Baker Calcium Nitrate. The exceptionally low copper and manganese contribute to longer life for your latex products, with less tendency to oxidize and become brittle or too soft.

These features of Baker Calcium Nitrate and Zinc Nitrate also are helpful to manufacturers of rustproofing specialties, textile finishes, pigments, adhesives and lithographic materials.

Because of the low melting points and deliquescent nature of these chemicals, they are packaged with polyethylene liners and are stored in an air conditioned warehouse at a temperature below 85°F.

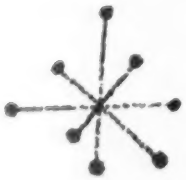
Write for samples and prices for these new *flaked* products, Calcium and Zinc Nitrate Technical.

CALCIUM NITRATE, Technical Flake	*Typical analysis*
Assay (as $Ca(NO_3)_2$)	71.8 %
Water of Hydration	27.6 %
Insoluble and NH_4OH Ppt.	0.03 %
Ammonium Nitrate (NH_4NO_3)	0.1 %
Magnesium & Alkalies (as NO_3)	0.4 %
Iron (Fe)	0.0003%
Copper (Cu)	0.0004%
Manganese (Mn)	0.001 %
pH of 5% Solution	6.3
Thin (0.025 in.) flakes about ½ inch in size with the following typical mesh analysis:	
On U.S. No. 4	45%
Thru U.S. No. 20	8%

ZINC NITRATE, Technical Flake	*Typical analysis*
Assay (as $Zn(NO_3)_2$)	74.2 %
Water of Hydration	25.6 %
Insoluble Matter	0.008 %
Iron (Fe)	0.001 %
Lead (Pb)	0.005 %
pH of 5% Solution	5.1
Thin (0.035 in.) flakes about ½ inch in size with the following typical mesh analysis:	
On U.S. No. 4	26%
Thru U.S. No. 20	9%

PURITY BY THE TON
–for production use

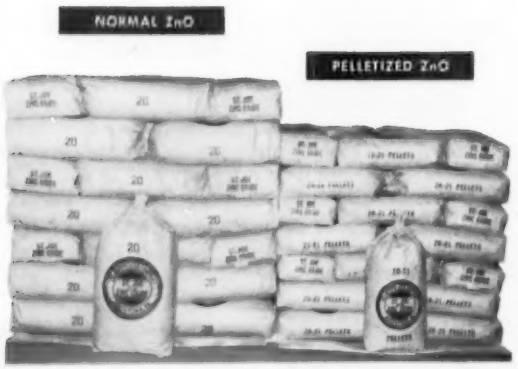
J. T. Baker Chemical Co.
REAGENT · CHEMICAL · FINE · INDUSTRIAL
Phillipsburg, New Jersey.



* space

costs

money



Reduce storage space substantially by specifying **ST. JOE surface-treated ZINC OXIDE in PELLET FORM**. Other advantages: Free-flowing — improved handling properties • Freedom from dustiness — better plant housekeeping • Faster incorporation in rubber • Superior dispersion in rubber.

ST. JOSEPH LEAD COMPANY
250 PARK AVENUE, NEW YORK 17, N. Y.
Plant & Laboratory: Monaca (Josephtown) Pa.

is a nasty word to rubber!

Ozone cracking in rubber is expensive, in sales lost and user dissatisfaction. Protect your rubber products from this danger with Universal's high potency antiozonants, UOP 88 and UOP 288.

Developed by Universal, these antiozonants have proven that they can provide complete protection to tires, or other rubber products under both dynamic and static exposure.

We'll be glad to recommend the best UOP 88 or 288 formulation to protect your product from ozone cracking and help it maintain the appearance and the service built into it.

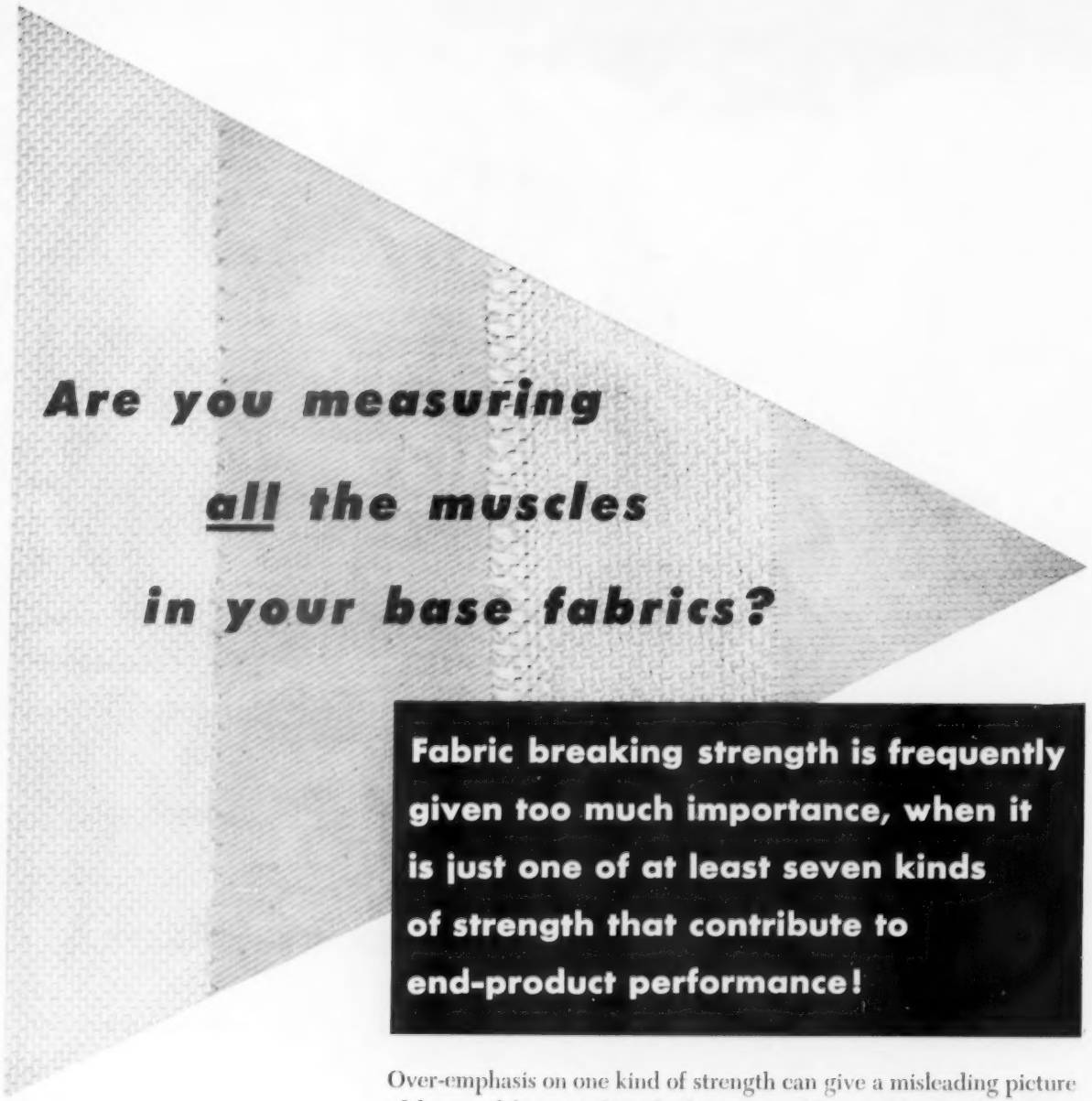
UOP 88® and 288
TRADEMARK
RUBBER ANTIOZONANTS

UOP®

PRODUCTS DEPARTMENT

UNIVERSAL OIL PRODUCTS COMPANY

30 ALGONQUIN ROAD
DES PLAINES, ILLINOIS, U. S. A.



Are you measuring all the muscles in your base fabrics?

Fabric breaking strength is frequently given too much importance, when it is just one of at least seven kinds of strength that contribute to end-product performance!

Over-emphasis on one kind of strength can give a misleading picture of how a fabric-reinforced plastic or rubber product will behave. Depending on end use, the impact, shear, flex, tear, burst or stitch strength can be just as decisive as breaking strength. All together, they permit a much more dependable estimate of product capabilities.

When your base fabric is one of the many provided by Wellington Sears for coating, laminating, combining and rubberizing, you know that its strength *and all other properties* have been considered in the light of your specific need. And moreover you know that a century of experience is working for you, to anticipate and help solve your working-fabric problems.

New Booklet Now Ready! Write Dept. G-3, for "Fabrics Plus"

Wellington Sears

FIRST In Fabrics For Industry

For Mechanical Goods, Coated Materials, Tires, Footwear and Other Rubber Products

Wellington Sears Co., 65 Worth St., New York 13, N. Y. • Atlanta • Boston • Chicago • Dallas • Detroit • LosAngeles • Philadelphia • San Francisco • St. Louis

In these five Standard Units are all the necessary components to control effectively the degradation mechanisms that take place in polyvinyl chloride resins on aging, during heat processing or on exposure to sunlight. They are widely used alone and in combinations for specific effects in clear and opaque stocks. Their advantages have been proven over other tested materials, such as those based on tin (which frequently decolorizes effects of degradation without correcting them) or on lead (which frequently contributes to oxidation and breakdown on aging). We also supply combinations of components selected from these five Standard Units, to correct special conditions encountered in each Vinyl Processing Industry.

Write for information about stabilizers designed for versatile and inexpensive use in formulations employed in your particular vinyl processing industry.

Is it for—

Quality Vinyl Flooring?
Non-Plating Calendered Stocks?
Maximum Clear Sheets?
Non-Sulfur Staining Films?
Low Cost Clear & Opaque Hose?
Top Physical Properties in Rigids?
Air-Releasing Plastisols?
Controlled Slush Molding?

This Stabilizer System is for

CLEAR SHEETS

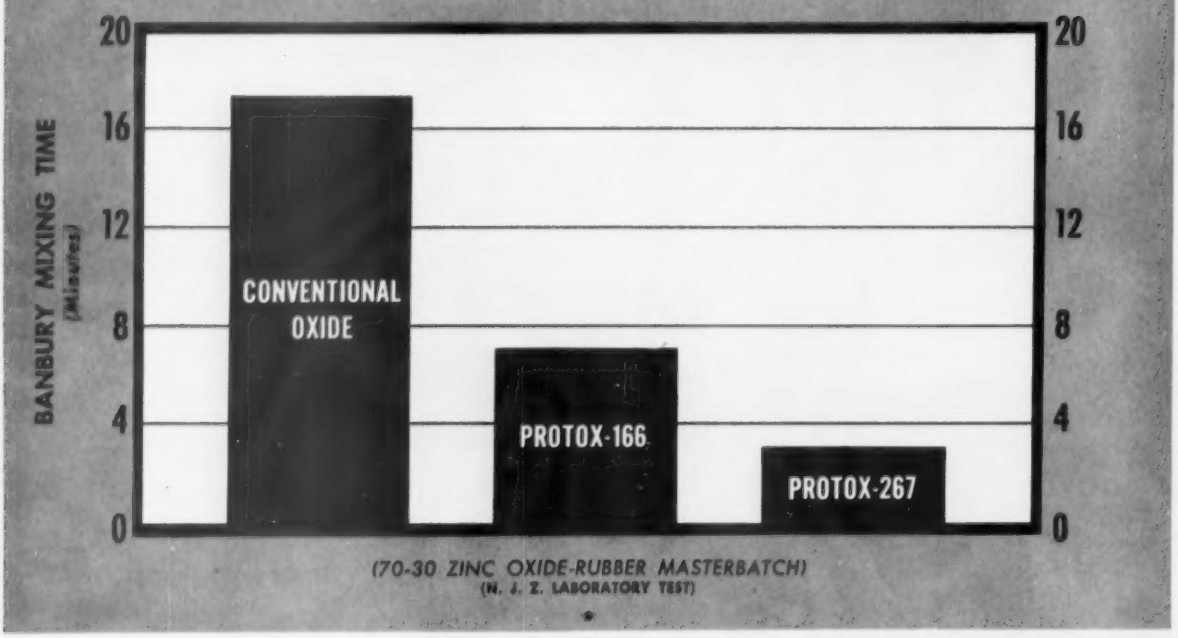
Cd 2-V-4

Org 8-V-1

The HARSHAW CHEMICAL Co.

1945 E. 97th STREET • CLEVELAND 6, OHIO

HOW PROTOX* ZINC OXIDES Cut Banbury Mixing Time



PROTOX-166

Mixes faster than conventional unpelleted American Process zinc oxides of similar particle size. The reason: It is surface-treated with propionic acid. Rubber readily wets the zinc propionate coating on Protox-166 and disperses that oxide fast and thoroughly.

PROTOX-267

Mixes even faster than Protox-166 because it is both surface-treated with propionic acid and pelleted. In short, it is pelleted Protox-166. The pellets incorporate rapidly into rubber and the propionate coating results in quick dispersion.

So whether you use an unpelleted or a pelleted zinc oxide, choose a Protox grade to cut Banbury mixing time.

Protox zinc oxides come in a range of particle sizes to meet all your needs. And, most important, only Protox oxides have the unique propionate surface for fast mixing and thorough dispersion.

*U. S. Patents 2,303,329 and 2,303,330.

THE NEW JERSEY ZINC COMPANY

Producers of Horse Head Zinc Pigments

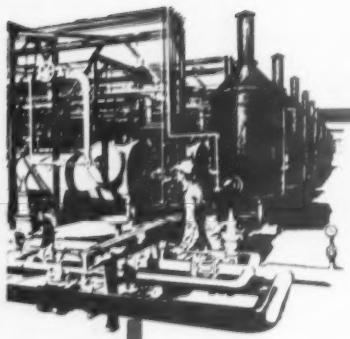
... most used by rubber manufacturers since 1852

160 Front Street, New York 38, N. Y.

HORSE HEAD PRODUCTS

QUALITY PERFORMANCE

UNITED CARBON BLACKS



KOSMOS 70

KOSMOS 70 ISAF is the ideal black for many applications. It is widely favored in natural and synthetic rubbers for tread stocks and camelback. It does well in processing and imparts exceptional reinforcement, improved tread wear, and better resistance to cracking.

THESE QUALITIES have brought a high demand for Kosmos 70 for toughest treads, maximum mileage tires, and for gruelling high-speed highway operations.

KOSMOS 70 and the other fine carbon blacks bearing the UNITED trademarks are made to meet the highest standards. Their excellence is recognized everywhere.

UNITED CARBON COMPANY, INC.

A subsidiary of United Carbon Company

CHARLESTON 27, WEST VIRGINIA

NEW YORK
BOSTON

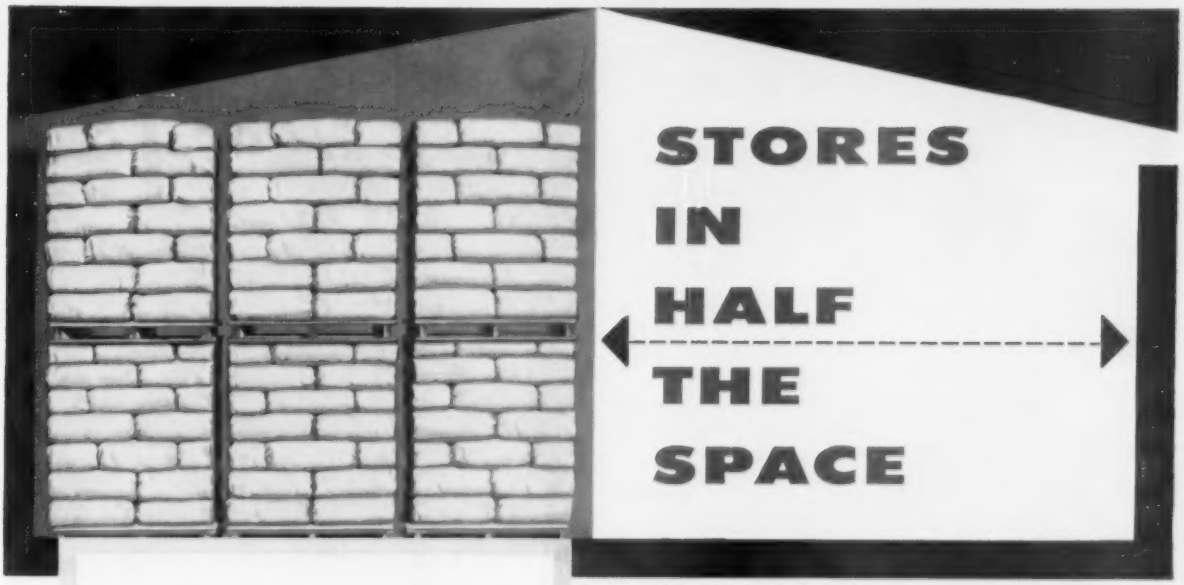
AKRON
LOS ANGELES

CHICAGO
MEMPHIS

IN CANADA: CANADIAN INDUSTRIES, LTD.

AZODOX

New, Higher Density Zinc Oxide



HERE ARE OTHER IMPORTANT REASONS WHY AZODOX IS BEST FOR YOU

Increased Mixing Capacity. AZODOX incorporates readily, disperses completely in both hard and soft stocks, at high or low concentrations, on the mill or in the Banbury. No hard-crusted agglomerates are present in AZODOX to cause mixing and dispersion difficulties.

Physical Properties Unchanged Except for Density. Surface area, particle size and shape, color and all other physical properties of AZO-ZZZ, American Process, zinc oxides are unaltered. *Apparent density only is changed.* All chemical properties are unchanged.

Flows More Freely, Less Dusting than conventional zinc oxides.

AZODOX Cuts Your Costs. Faster handling, easier storing, quicker mixing save you money.

AZODOX is factory-tested and proved. Now available in sample lots or carload quantities for your use *at the same price of conventional zinc oxides.*

AZODOX available in surface treated form if desired.

AZODOX is a revolutionary new form of zinc oxide (de-aerated). With twice the density, half the bulk of conventional zinc oxides, AZODOX is the answer to your storage problem. AZODOX comes to you in an easy-to-handle small package, shaped to permit closely packed, unitized shipments. *And the perfect texture of the material remains unchanged.*

AZODOX is available in all grades of American process lead-free zinc oxide.

American Zinc sales company

Distributors for
AMERICAN ZINC, LEAD & SMELTING COMPANY
COLUMBUS, OHIO • CHICAGO • ST. LOUIS • NEW YORK

Goodrich-Gulf Chemicals, Inc.

After processing, Ameripol rubber is compressed in bales, dusted or wrapped for protection in plastic film. The dusted or film wrapped bale can be fed directly into Banbury in your plant.

all Ameripol users get "Big-order" service

ALL users of Ameripol man-made rubber like the big-order service they're getting through our expanded production and warehousing service.

Your orders are filled from warehouses in Chicago, Akron, or Port Newark, N. J., or from our giant plants in Institute, W. Va., or Port Neches, Texas. Goodrich-Gulf is one of the largest producers of man-made rubber, and is geared to serve you promptly.

Ameripol is recognized as the preferred rubber for tires and floor tile, for a wide range of industrial products from conveyor belts to extruded gaskets. Call us for your requirements.

Goodrich-Gulf Chemicals, Inc.
3121 Euclid Avenue Cleveland 15, Ohio

Ameripol RUBBER

Cold Non-Oil Polymers
•
Cold Oil-Extended Polymers
•
Hot Non-Oil Polymers

THE NAME TO REMEMBER FOR QUALITY BACKED BY YEARS OF RESEARCH AND EXPERIENCE

having difficulty filling intricate molds?

ADAMSON UNITED

injection molding

"BARREL PRESS"

..... may solve your problem

Designed for fast, automatic stock injection, higher mold clamping forces and greater accuracy in the production of molded rubber products, this new ADAMSON INJECTION BARREL PRESS eliminates many of the problems encountered in the use of conventional rod-type units.

A solid ram equal in diameter to the platen dimensions supports practically the entire bolster area. Platen pressures up to 1800 lbs. per sq. in. can be transferred to the mold with a minimum of deflection and "flash," on the same accumulator lines used for operating your present presses. Faster, high pressure press work can be maintained over long periods with less down time; and because of the extreme accuracy of the press, material savings can be made in product finishing costs.

We'll be glad to furnish you details on the new ADAMSON INJECTION MOLDING BARREL PRESS, or on any other type of rubber processing equipment. Your inquiry will entail no obligation.

ADAMSON UNITED COMPANY

730 Carroll Street, Akron 4, Ohio

SALES OFFICES IN PRINCIPAL CITIES

Subsidiary of United Engineering and Foundry Company • Plants at Pittsburgh, Vandergrift, Wilmington, Youngstown, Canton

. . . . SUPPLIERS

Time's running out

If you haven't yet ordered

advertising space in the

1957-58 RUBBER RED BOOK

better send in

your reservation before

the April 15 closing date.

Rubber Age · 101 West 31st Street · New York 1, N. Y.

Cure-alls won't improve your digestion...

...but Velsicol custom made reclaiming oils will!

Rubber reclaimed by the alkali, pan-process or neutral digester process swells more readily, has lower tailings, has desirable plasticity, and is easier to incorporate into synthetic or natural rubber when you use Velsicol reclaiming oils custom-made for your operating conditions. Let a Velsicol representative study your needs, and make recommendations. No cost or obligation.

LOOK FOR THIS MAN Your Velsicol representative . . . a qualified chemist who will help you make better products for less!

Mail the coupon now for free technical literature!

VELSICOL
CHEMICAL CORPORATION

VELSICOL CHEMICAL CORPORATION
330 East Grand Avenue, Chicago 11, Illinois

☐ Please have a salesman call to discuss custom made reclaiming oils
☐ Please send a sample for pilot plant use.
☐ Please send technical literature. RA-37

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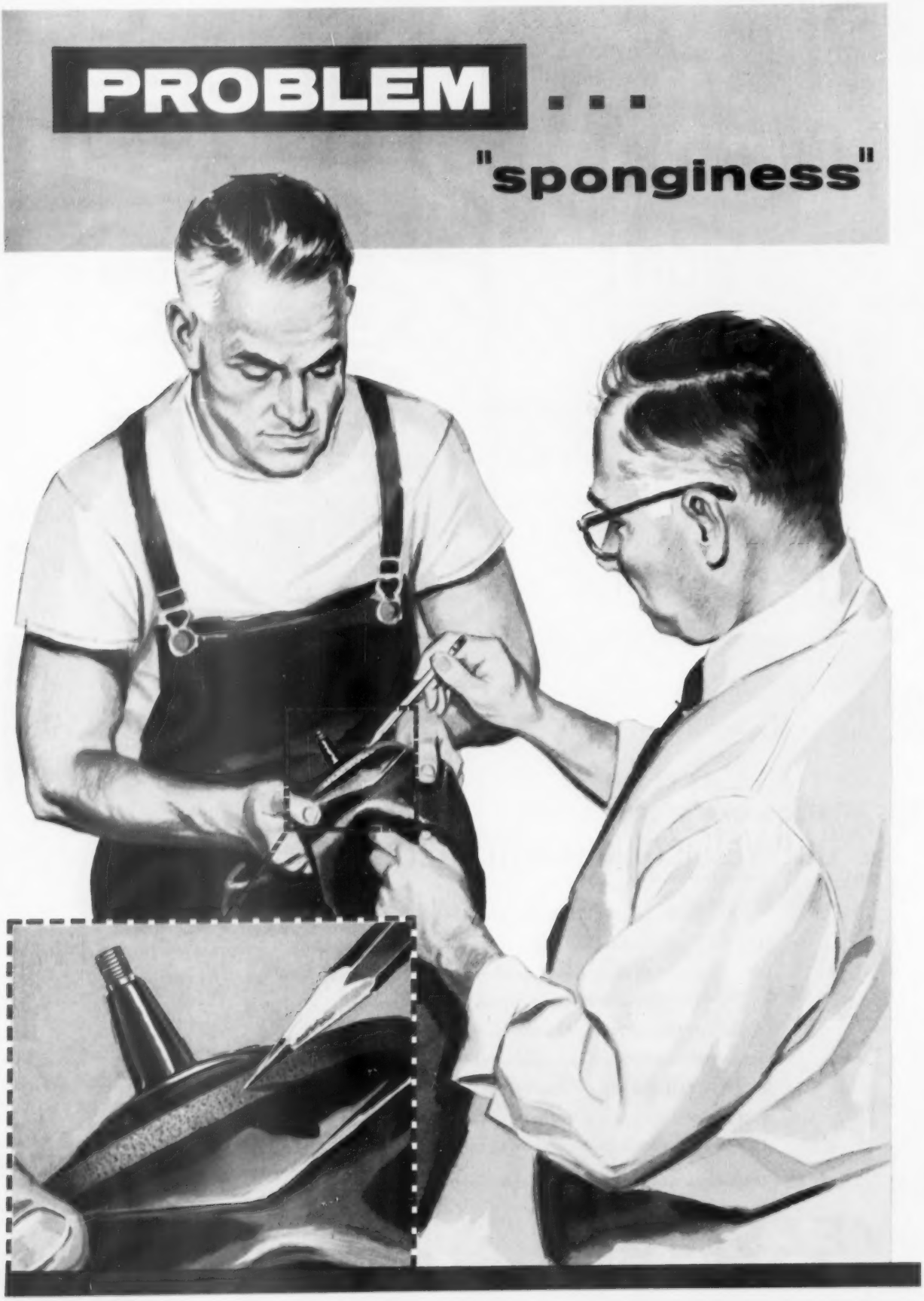
Company_____
Address_____
City_____ Zone____ State_____


PROBLEM . . .
"sponginess"

under valve base

SOLUTION . . .

KURE-BLEND MT

This very problem faced a leading tire tube producer six months ago. The problem was completely solved by adding Kure-Blend MT during stock processing. Several others have proved the same benefits since. This curing problem could have been solved by increasing cure time ½—1 minute, but Kure-Blend solved it without any increase in time.

Kure-Blend®, a 50 GRS-50 TMTD latex-compounded masterbatch, provides faster, more even dispersion, thus allowing full advantage to be gained from TMTD used for acceleration.

Kure-Blend offers these additional advantages:

- **Faster, easier incorporation**
- **Can be more accurately weighed**
- **Indefinitely storage-stable**
- **No dusting**
- **Assures uniform cure**
- **No premium cost**

There's no need to increase cure time—just add Kure-Blend MT to be sure of tube cure!

For literature and samples, write to:

THE GENERAL TIRE & RUBBER COMPANY

Chemical Division

AKRON, OHIO

Creating Progress Through Chemistry

Chemical Division GENERAL THE GENERAL TIRE & RUBBER CO. KURE-BLEND®

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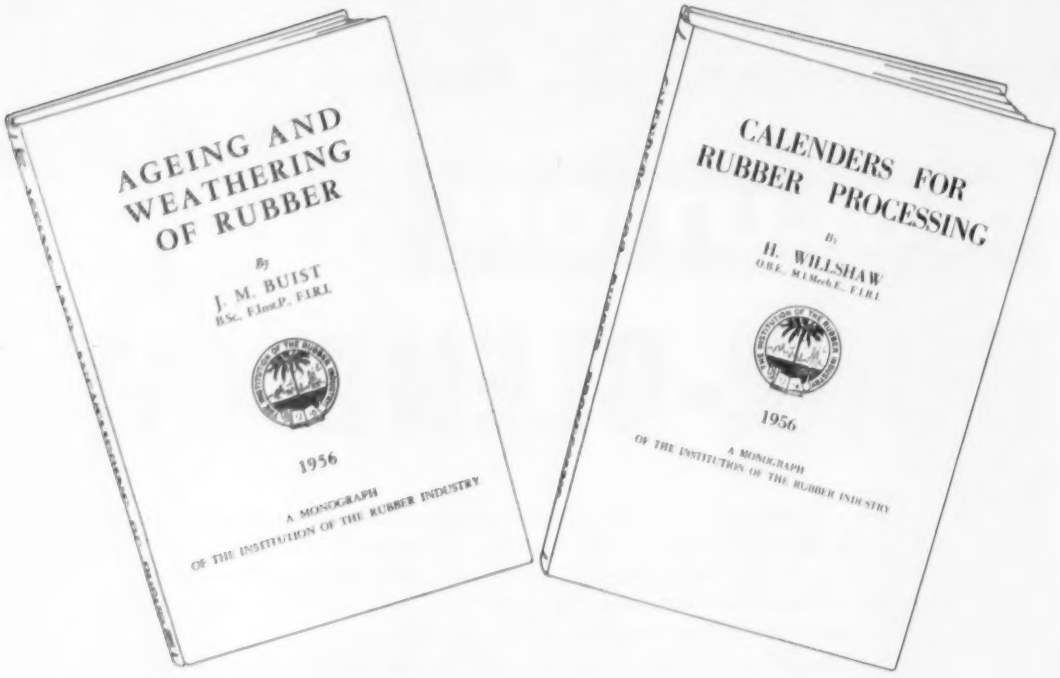

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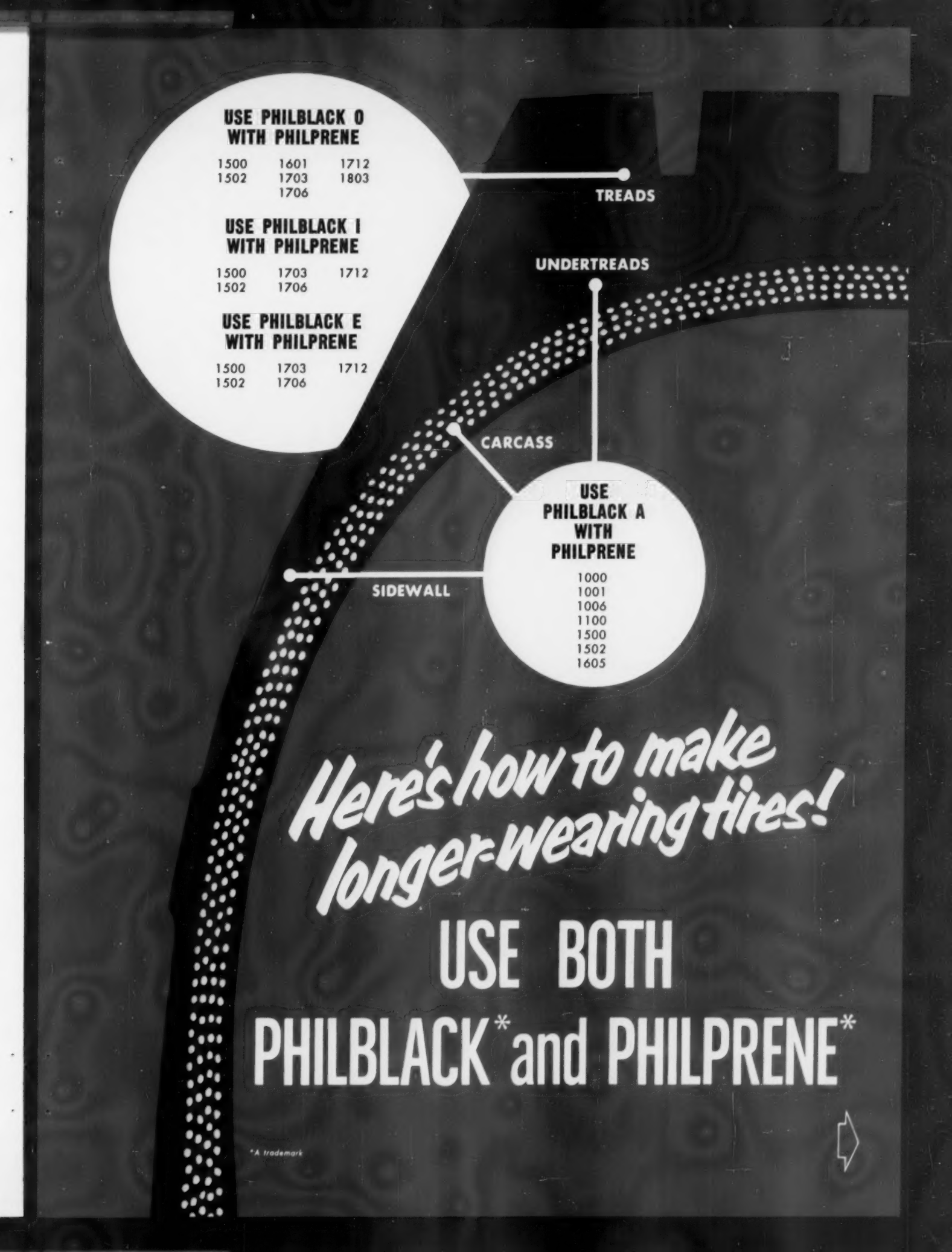
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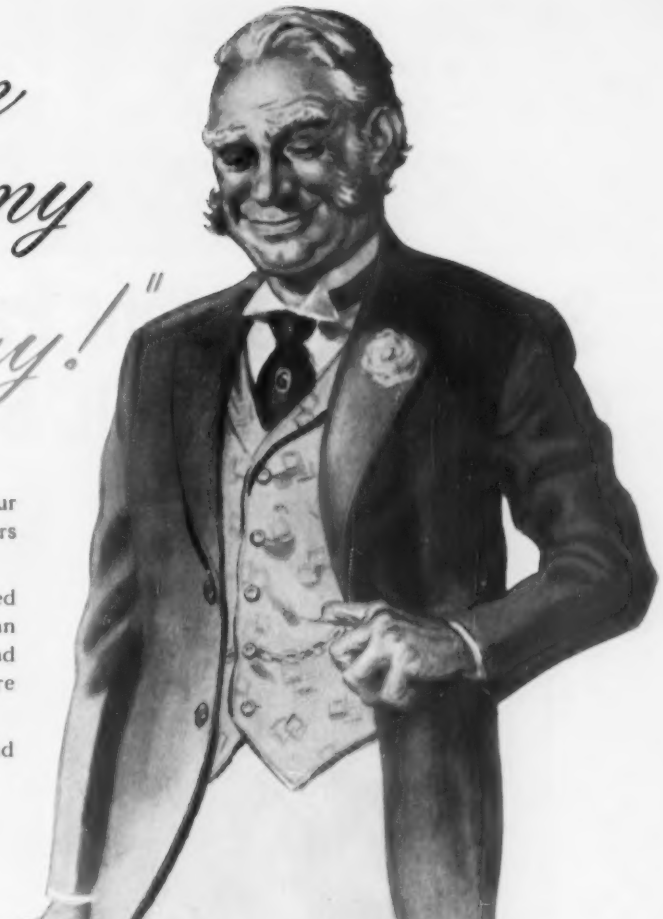

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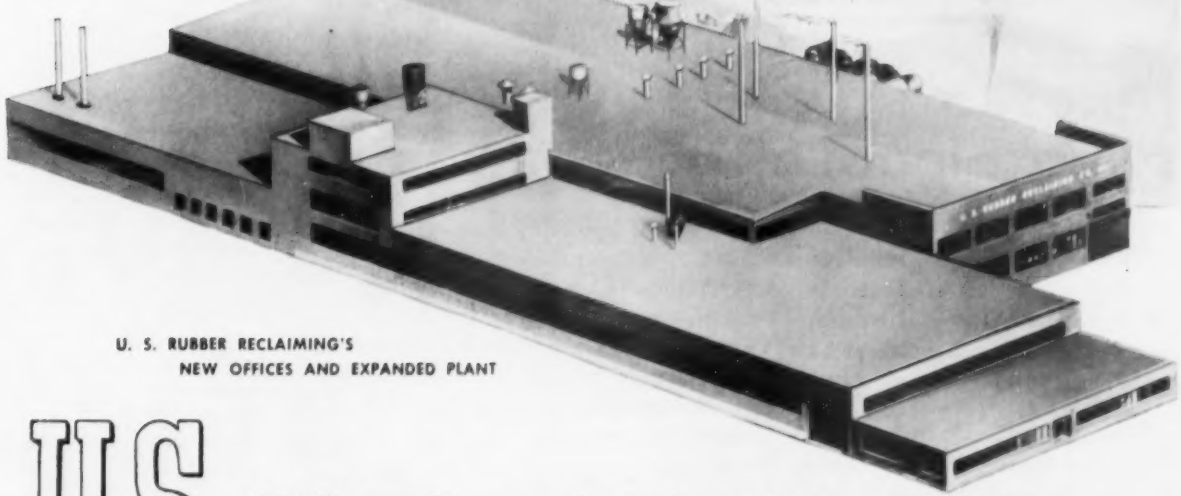

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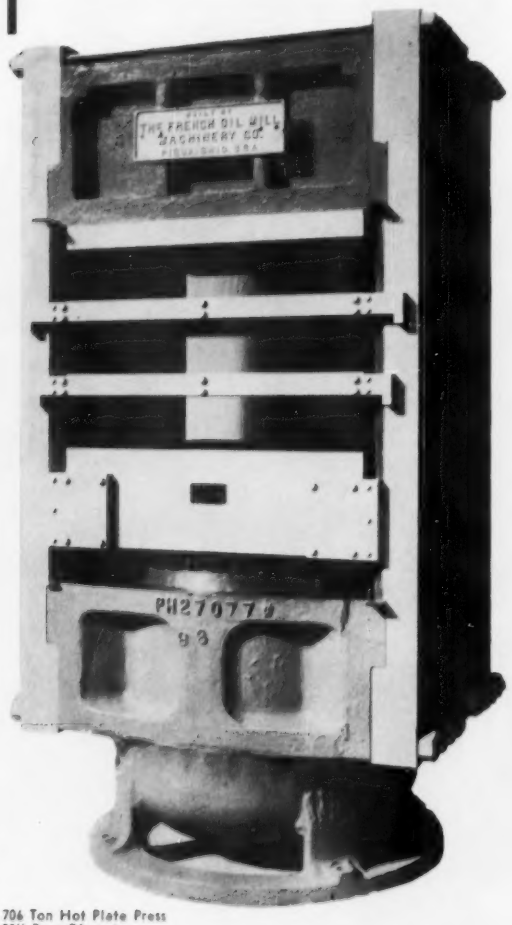

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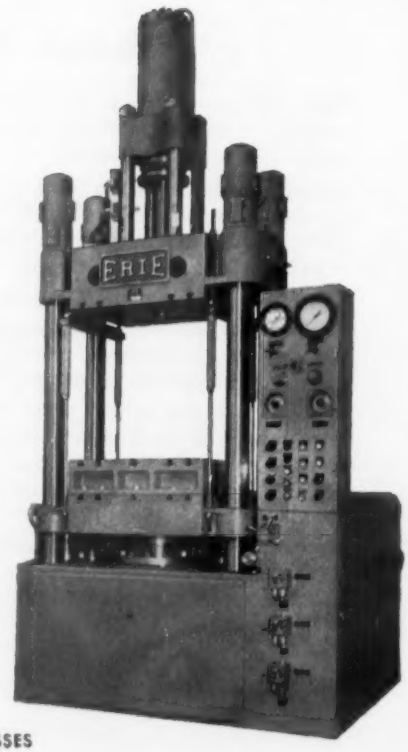

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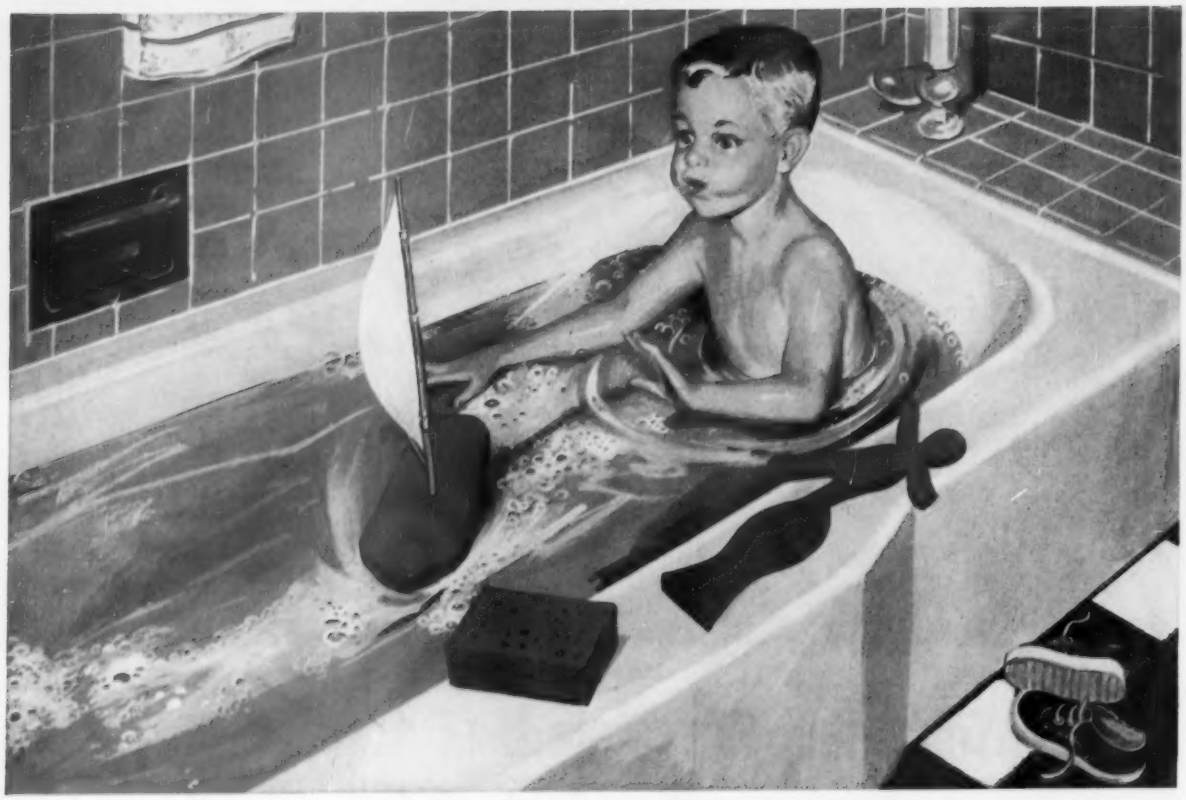

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Rubber Age

Vol. 80, No. 6 MARCH, 1957

Compounding Silicone Rubber For Minimum Shrinkage

By J. J. DEASY and B. B. WHITE

Silicone Products Department, General Electric Company
Waterford, New York

STUDIES of the shrinkage that all rubber stocks exhibit during vulcanization is a subject on which little has been published. The majority of rubber compounders have not had to pay serious attention to the subject for the simple reason that shrinkage variations have rarely caused major production troubles. The exception is the compounder of stocks used in O-rings and other precision molded parts where shrinkage plays an important role in meeting the close dimensional tolerances required for satisfactory parts.

Organic rubber stocks most commonly used for mechanical molded goods have a linear shrinkage in the range of 1.5 to 1.8 percent as measured on a standard ASTM sheet. Early silicone rubber had a shrinkage of about 5 to 7 percent after mold and oven cure. When these high shrinkage silicone rubber stocks were molded in tooling designed for organic rubber stocks, the parts produced were considerably undersize. Special tooling, an added expense, was necessary to produce specification parts. Even this measure was not always effective because these higher shrinkage compounds also showed relatively wide variations in shrinkage characteristics. Practically speaking, the manufacture of precision molded silicone rubber parts presented a trying task to the industry.

Note: This paper was presented before the Division of Rubber Chemistry, American Chemical Society, at Atlantic City, N. J., September 19, 1956.

The first step in the direction of lower shrinkage took place in 1953. The General Electric Company introduced a low volatile silicone polymer and compounds based upon it that had a nominal shrinkage of 3 percent after complete cure. Although this was a favorable move in reducing the variation in shrinkage, the median shrinkage was still too high to allow the use of standard tooling for precision molded parts. Further progress in reducing the shrinkage of silicone rubber compounds was needed.

Such progress has been accomplished. Silicone rubber compounds are now available with shrinkage equivalent to that of organic rubbers most commonly used in mechanical goods molding. It is the purpose of this paper to present the technology behind these new compounds and the results that have been obtained to date by molders of O-rings who have appraised their shrinkage performance. This paper is not intended to describe comprehensively the extensive developmental work that was necessary to arrive at a minimum shrinkage silicone rubber compound. Rather, it is planned to describe a series of experiments designed to illustrate the more important points determined in the complete developmental program.

The compounding of silicone rubber stocks is still a relatively simple process which consists of combining a suitable gum, reinforcing filler and curing agent on standard rubber equipment. The new technology does not depart from this simplicity. The more detailed de-

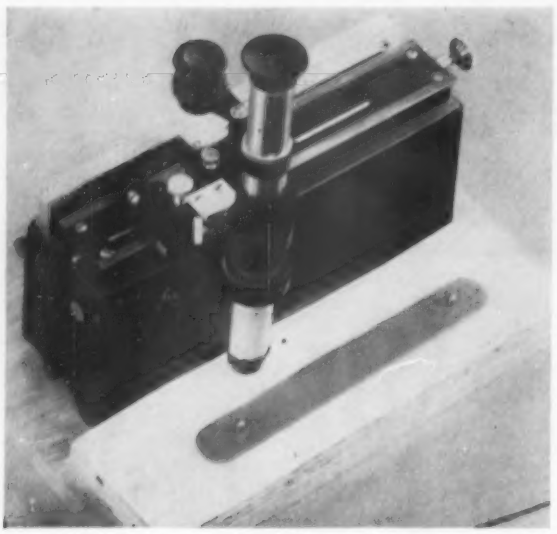

FIG. 1 — Measuring shrinkage with cathetometer, using molded rubber strip and conical-topped steel bench-marks.

velopment program led to the conclusion that minimum shrinkage may be obtained by choosing a specific combination of the three basic ingredients. As will be shown, the specific combination involves (1) a mixture of silica fillers, (2) a silicone gum of low volatility, and (3) a low temperature peroxide-type curing agent.

A primary concern in developing the technology to be described was that of accurately and consistently measuring the shrinkage. Ideally, at least three criteria would have to be present to implement the consistent measurement of shrinkage. These criteria would be such that any internal stress would be eliminated. If thermal and plastic equilibrium were achieved before cure took place, and if instantaneous cure throughout the rubber were possible, practically all internal stress would be either eliminated or equally applied over the total volume of rubber. Seldom are any of these three criteria present in an elastomeric system, silicone rubber included.

Factors in Plastic Equilibrium

There are many features of a rubber compound that prevent plastic equilibrium. Effects caused by thermal expansion, preform shape, grain inducement, cure characteristics, stock age and history, filler nature, filler loading, type of lubricant, rate of mold closure, molding pressure, presence of reclaim, oven cure and many others may have an appreciable part in preventing plastic equilibrium. It is also well known that most organic rubber compounds go through some degree of thermoplasticity during cure; consequently, some or all of the nerve, structure, or grain effects may disappear when molding organic rubber. Such is not the case with silicone rubber because the base polymer is less thermoplastic and because peroxide-type cures proceed at a rapid rate.

It is apparent that thermal equilibrium is not attained prior to cure because the heating process is one of conduction. Since normal curing processes are thermochemical in nature, it is impossible to attain instantaneous cure throughout the mass of rubber, again because the heating is by conduction. It is evident that most rubber compounds, including silicone rubber, do not present the ideal conditions for determining shrinkage. However, the compounding, remilling, preforming, molding, and curing process can be carried out in a way to yield results that are commercially useful.

Procedure

The procedure used for the experimental results to be reported was adjusted as far as possible to eliminate or at least hold constant many of the effects that force departure from the ideal conditions. Preform shape, stock age and history, volume loading, molding pressure, rate of mold closure and oven cure were held as constants. Grain effects were minimized. The variables, therefore, were nature of the filler, thermal expansion and cure characteristics.

The compounding was done on a 12- by 20-inch mill in two stages. Gum and reinforcing fillers were combined first and bin-aged one week. The curing agent was added during the remilling and the preform was cut from the mill sheet with the grain the long way. Grain effects in the preform were reduced by frequently introducing the stock to the nip end-wise so that the new grain was always formed at right angles to that of the previous pass.

The experimental method of determining shrinkage consisted of measuring the distance between two bench marks molded into a strip of rubber 1 by 8 by 0.135 inches in size. The bench marks were holes about 6 inches apart into which conical topped steel pins were inserted. The distance between the steel cones in the strip and between the studs in the mold were measured with a cathetometer. The linear shrinkage determined was based on the dimensions at room temperature of the cavity and the molded strip. The equipment used is illustrated in Figure 1.

Experimental Compounding

The experimental compounding was designed to demonstrate the effect of reinforcing agent, gum, and curing agent on shrinkage. These effects are examined in three sections: (1) Filler Effect, (2) Gum Effect, (3) Curing Agent Effect.

Filler Effect: This section explored the effect of various ratios of Celite 350 and Hi-Sil X303 on shrinkage. Although variable ratios were used, the total filler volume was held constant at 40 volumes per 100 volumes of silicone gum. The materials used were SE-33 silicone gum, a low volatile polymethylsiloxane type gum containing a small amount of unsaturation; Celite 350, a naturaly occurring silica; Hi-Sil X303, a precipitated type silica; Cadox TS, a 50 percent dispersion of bis (2,4-dichlorobenzoyl) peroxide in silicone oil. The recipes and data for this experiment are shown in Table I.

The shrinkage results were interesting and unexpected

TABLE I—FILLER EFFECT

Recipe	A	B	C	D	E
SE-33	98.0	98.0	98.0	98.0	98.0
Celite 350	84.0	63.0	42.0	21.0	...
Hi-Sil X303	...	19.5	39.0	58.5	78.0
Cadox TS	2.0	2.0	2.0	2.0	2.0
Mold Cure	10 min./260°F.				
Oven Cure	24 hrs./480°F.				
Shrinkage, %	2.74	2.53	2.00	2.64	3.04
Specific Gravity	1.333	1.318	1.310	1.297	1.282
Dielectric Strength v/m	582	546	512	501	424

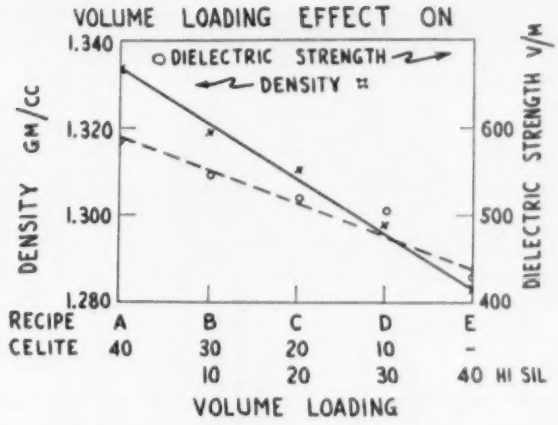

FIG. 2—Effect of various ratios of Celite 350 and Hi-Sil X303 on shrinkage.

because a minimum point, 2 percent, was reached when approximately 20 volumes of Celite 350 and 20 volumes of Hi-Sil X303 were present (Recipe C). The reason for this behavior is not known but one logical explanation might be an increase in porosity.

Such porosity could cause expansion after molding that could well be confused with lower shrinkage. However, if porosity is present, one would expect that specific gravity and/or dielectric strength measurements would detect it. Both specific gravity and dielectric strength decreased in linear fashion as Hi-Sil X303 ratio increased, as shown in Figure 2. This result was expected because Hi-Sil X303 is both less dense and poorer in dielectric strength contribution than Celite 350. The presence of porosity would have disturbed this linear relationship; consequently, the degree of micro-porosity in Recipe C was evidently no greater than normal.

Unexpected Shrinkage Results

The unexpected shrinkage results may be due to the great difference in particle size between the fillers. Celite 350 is approximately 50 to 300 times larger in particle diameter than Hi-Sil X303. Such a major difference in particle size may introduce some unusual degree of compound compressibility; this possibility is being investigated. Even though the explanation is elusive at the moment, the fact is evident that certain ratios of Celite 350 and Hi-Sil X303 are most effective in depressing the shrinkage of SE-33 silicone gum.

Gum Effect: This study compared the saturated type of polymethylsiloxane gums (SE-76 and SE-30) with the unsaturated type (SE-31 and SE-33). One gum in each pair is of the low volatile variety (SE-30 and SE-33) and the others (SE-31 and SE-76) are somewhat higher in volatility. Recipe C of the preceding section was used as a control because its particular filler ratio gave the lowest shrinkage. A deviation in curing agent quantity, as shown in Table II, was necessary in Recipes G and H because saturated gums require more curing agent than the unsaturated type.

As expected, the shrinkage results fell into two groups with the low volatile gums (SE-30 and SE-33) yielding the lower shrinkage. As mentioned previously, the first step in lowering shrinkage of silicone rubber compounds was implemented by the introduction of low volatile silicone gum. The relatively high degree of volatiles in

TABLE II—GUM EFFECT

Recipe	C	F	G	H
SE-33	98.0	....	....	....
SE-31	....	98.0	....	....
SE-76	....	....	98.0	....
SE-30	....	....	....	98.0
Celite 350	42.0	42.0	42.0	42.0
Hi-Sil X303	39.0	39.0	39.0	39.0
Cadox TS	2.0	2.0	5.0	5.0
Mold Cure	10 min./260°F.			
Oven Cure	24 hrs./480°F.			
Shrinkage, %	2.00	4.05	4.15	1.91

some silicone gums is due to a polymerization process which terminates with a large fraction of high molecular weight material as well as a significant fraction of low molecular weight material. This low molecular weight fraction can be materially reduced by the silicone gum manufacturer. A compound based on low volatile gum will have lower weight loss and shrinkage; consequently, the evidence indicates that a low volatile gum should be used for a minimum shrink compound.

Four Peroxides Investigated

Curing Agent Effect: The third part of this investigation concerned the curing agent effect on shrinkage, using four well-known peroxides. Because the activation temperature of each peroxide is different, this also was a study of the effect of mold temperature on shrinkage. The peroxides used were Cadox SG, a 50 percent dispersion of benzoyl peroxide in silicone oil; Di-Cup 40C, a 40 percent concentration of dicumyl peroxide in calcium carbonate; DTBP, ditertiary butyl peroxide; and Cadox TS, bis (2,4-dichlorobenzoyl) peroxide, as the control. The relative amount of each peroxide used was based on the molecular weight ratio of the individual peroxides to that of Cadox TS. Recipe C remained the control recipe.

As would be predicted from thermal expansion considerations, in this curing agent investigation the shrinkage increased as the molding temperature increased as shown in Table III. There was also an indication that Cadox TS reduced shrinkage more than Cadox SG, even though both were used at the same mold temperature. This difference may mean that Cadox TS is a more efficient curing agent, or the difference may be caused by a faster cure rate. Accordingly, the cure rates of Recipes C and I were determined with a Mooney viscosimeter. The

TABLE III—CURING AGENT EFFECT

Recipe	C	I	K	J
SE-33	98.0	98.0	98.0	98.0
Celite 350	42.0	42.0	42.0	42.0
Hi-Sil X303	39.0	39.0	39.0	39.0
Cadox TS	2.0	....	....	....
Cadox SG	....	1.27	....	....
Di-Cup 40C	....	....	1.7	....
DTBP	....	....	....	0.382
Mold Cure, min.°F.	10/260	10/260	10/320	10/340
Oven Cure	24 hrs./480°F.			
Shrinkage, %	2.00	2.38	2.96	3.28

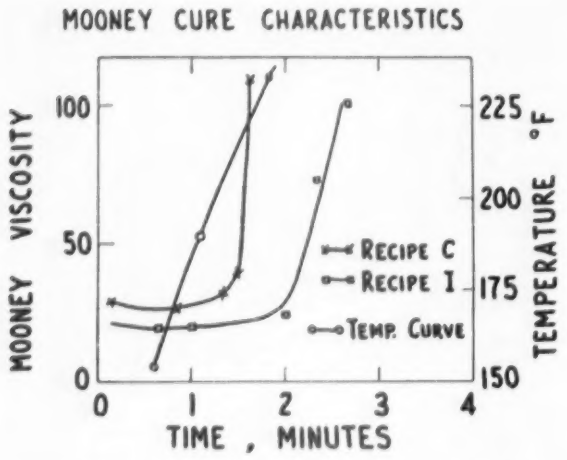

FIG. 3—Cure rates of Recipes C and I determined with a Mooney viscosimeter.

Mooney cure characteristics (Figure 3) show that the Cadox TS compound (Recipe C) passed the incipient vulcanization point* 31 degrees ahead of the Cadox SG compound (Recipe I). It may well be that shrinkage would correlate more closely with Mooney cure temperature than with the molding temperature. The conclusion formed here is that the use of Cadox TS, a low temperature curing agent, helps to reduce the shrinkage.

Significance of Experimental Results

The results of the three preceding investigations indicate that there should be a best ratio of Celite 350 and Hi-Sil X303 fillers that will yield a minimum shrinkage and if a low volatile silicone gum and a low temperature curing agent are also used, shrinkage can be depressed further. Further detailed studies showed that as the total filler loading was increased to raise durometer, the ratio between the two fillers had to be varied. With these facts in mind, the three formulations of Table IV were developed to cover 60, 70, and 80 durometer applications.

Experimental Molding of O-Rings

So far, the experimental shrinkage testing was confined to the laboratory and was based upon measuring the shrinkage of a molded strip of silicone rubber. Some evidence of the shrinkage that one would encounter in actually producing O-rings was necessary. In order to obtain such evidence, the International Packings Corporation agreed to mold O-rings from compounds having identical recipes used in the curing agent effect investigation. International Packings molded O-ring size AN 6227-23 in a ten cavity mold. Ten heats of each compound were run and the average shrinkage of each cavity was determined. The over-all shrinkage average was then calculated.

The work done at International Packings, compiled in Table V, corroborated our laboratory findings, in that Recipe C was shown to have lowest shrinkage. Although specific values differed to some extent, the qualitative check is valid. It is apparent why O-ring molders determine O-ring compound shrinkage on O-rings rather than

* As defined in ASTM D1077-55T, paragraph 7 (a).

TABLE IV—SUGGESTED RECIPES

Durometer	60	70	80
SE-33	100.0	100.0	100.0
Celite 350	45.0	68.0	85.0
Hi-Sil X303	37.0	40.0	50.0
Cadox TS	2.0	2.0	2.0
Mold Cure, min./°F.	10/260	10/260	10/260
Oven Cure	4 hrs./480°F.		
Shrinkage, %	1.8	1.7	1.6
Compression Set, Method B 22 hrs./300°F., %	20.0	25.0	30.0

by following some theoretical formula or other empirical method. The deviation in shrinkage between the strip and the O-ring became greater as the molding temperature increased. No doubt the explanation could be found in one or more of the items listed early in this paper as the reasons why ideal shrinkage determination conditions were lacking.

Such deviations in shrinkage of the same material caused by different methods of determining shrinkage are well known to the precision molder. It is quite probable that shrinkage determinations of silicone rubber compounds as well as many other elastomers will remain empirical for some time to come. However, the various methods can be used with some degree of consistency to determine relative shrinkage between compounds provided one understands that the various methods may yield different shrinkage values.

Commercial Compounds

Three commercial compounds of 60, 70 and 80 durometer hardness and based on the three recipes shown in Table IV were introduced to the rubber industry about a year ago. Since that time considerable data have been produced, most particularly by the O-ring manufacturers, which corroborate our own findings. This has been true both in laboratory studies and in commercial O-ring production.

When the earlier, high-shrinkage silicone stocks were all that were available, the total shrinkage and the shrinkage variation were inherently so high that all other factors could be ignored. With the new compounds the nominal shrinkage is sufficiently low that other factors such as preform shape and size, mold flow, temperature, etc., become significant.

For a number of reasons, there is considerable variation in the methods used by O-ring manufacturers for the preparation of preforms. To illustrate that inherent shrinkage in the new silicone compounds has been reduced to the point where preform method becomes sig-

TABLE V—O-RING MOLDING RESULTS

Recipe	C	I	K	J
Mold Cure, min.°F.	10/260	10/260	10/320	10/340
Oven Cure	24 hrs./480°F.			
IPC O-Ring I.D. Shrinkage, %	2.11	2.25	2.58	2.53
GE Strip Shrinkage, %	2.00	2.38	2.96	3.28
IPC Strip Shrinkage, %	...	...	3.20	3.28

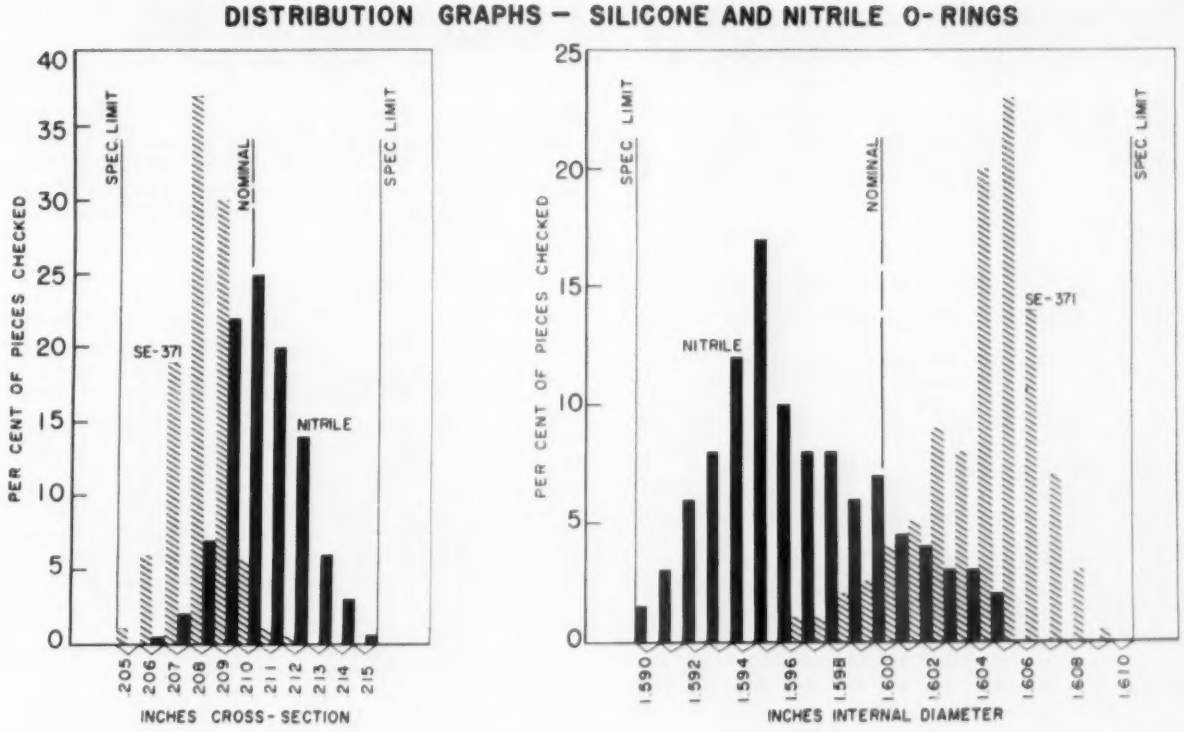

FIG. 4—Of a total of 4000 O-rings measured, 10% were inspected for internal diameter (graph at right) while the entire lot was inspected for cross-sectional dimensions.

nificant, we can look at some work done in the laboratory of the Garlock Packing Company. A number of AN 6227-28 O-rings were molded of SE-371 compound, using two different preforming techniques. O-rings which were preformed by slicing extruded tubing averaged 1.465 inches i.d., while O-rings which were preformed by extruding a solid rod, scarfing and splicing, averaged 1.482 inches i.d. Both values are within the specified dimension of 1.475 ±0.010 inches.

Further data were obtained from measurements made on more than 4000 O-rings meeting AN 6227-29 specification. These rings were produced by the Garlock Packing Company in the same mold, cut originally for nitrile rubber and allowing 1.2% shrinkage in i.d., 3.0% in cross-section. Half of the O-rings produced in this run were of a 70 durometer nitrile rubber, the other half SE-371 silicone rubber. Press conditions for the nitrile were 15 minutes at 320° F.; for the silicone, 4 minutes at 250° F. followed by 4 hours in a circulating air oven at 480° F. Ten percent of the rings were inspected for internal diameter on a projection comparator. The entire lot of 4000 rings was inspected for cross-sectional dimensions with a thickness gage. Figure 4 illustrates the data that was obtained in these measurements. Note that all O-rings, silicone and nitrile, were within the specified dimensions of 1.600 ±0.010 inches for i.d. and 0.210 ±0.005 inches for cross-section. Additional work done by Garlock showed that the nominal shrinkage factor of the new 70 durometer silicone rubber remained essentially constant, averaging 1.1%, in O-rings from one inch to 17 inches in diameter.

Considerable studies on the shrinkage of silicone rubber compounds in O-rings have also been performed by the Rubber Products Division of the Parker Appliance Company. Data received from them cover O-rings from 0.75 inches to 10 inches in diameter, and all three of the new compounds. Their work not only corroborates the shrinkage equivalency of the new silicone stocks, but also points out the uniformity of shrinkage over the above size range. A variation in i.d. in excess of 1.5% of the mean i.d. measurement almost never appears in their data; in 4-inch and 10-inch O-rings, the variation in i.d. actually ran between 0.1 and 0.4% of the mean i.d. dimension. These figures compare to variations between 2 and 3% reported by Parker in an earlier study of O-ring shrinkage on older "high-shrink" silicone compounds.

The Goshen Rubber Company was the first to confirm the shrinkage equivalency of the new compounds. A recent report from them states that O-rings in sizes from ½ inch to 8¼ inches in diameter have been run in standard tooling with required sizes and tolerances met. They report running over 100,000 rings of one particular size in production with tolerances reported as being met "very easily."

The studies made by the above O-ring manufacturers and others show that it is now commercially practical to produce silicone rubber O-rings and similar precision rubber parts in molds designed for organic rubbers. The progress made available by the technology described in this paper is illustrated in the graph of Figure 5. Here are shown typical median and limiting values for O-ring cross-sections as yielded by (a) a typical early high-shrinkage silicone rubber, (b) the first so-called "low shrinkage" silicone rubber based on a low-volatile polymer, (c) minimum shrinkage silicone rubber as described in this paper, and (d) a typical organic rubber (nitrile) used for O-ring production.

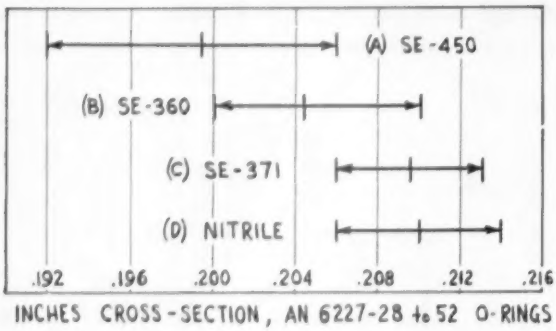

FIG. 5—Typical measured values for O-ring cross-sections.

Summary and Conclusions

Three basic conclusions may be drawn from the data presented:

(1) The compounding of silicone rubber to obtain a minimum of cured shrinkage depends upon a combination of:

(a) A mixture of fillers, in this case Celite 350 and Hi-Sil X303. Although the reason for this effect is not known, it is postulated that gross difference in particle size may account for the fillers' contribution toward reducing shrinkage.

(b) A silicone gum of low volatility, in this case SE-33.

(c) A curing agent with a low incipient vulcanization temperature, in this case Cadox TS.

(2) Because ideal conditions for shrinkage determination in reality never exist, empirical methods for shrinkage measurement are necessary in commercial application.

(3) This new technology has made commercially feasible the production of silicone rubber O-rings and precision molded parts of similar tolerance requirements in standard rubber tooling.

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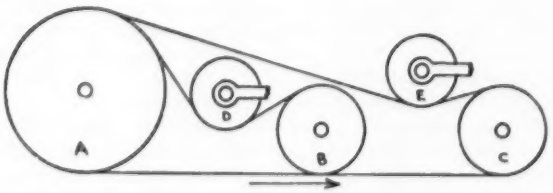
How to Arrange Rider Belt Drives

RIDER belts are usually considered poor engineering practice because of the wear that is likely to take place between the outside and inside belts and the greater creep of the rider belt with reference to the pulley wrapped by both belts. They are good engineering practice, however, as makeshifts. When a greater load is to be transmitted to a given line shaft by a motor, for example, and when that motor is incapable of delivering the power demanded, it is not uncommon to make up a drive similar to the one shown in the accompanying sketch. Generally, such arrangements are intended to be temporary only, but after they are once installed and seemingly give good service, no further change is made in many instances, except to apply better wrapper pulleys or belts that are more flexible and less likely to slip and creep.

By use of wrapper pulleys D and E it is possible to set the motors B and C closer to the driven machine. Perhaps wrapper pulley E will not be needed at all, for the straighter the upper belt the closer pulley C can be placed. Space is sometimes more important than high transmission efficiency.

When arranging a drive of this kind motor B should be the higher power motor. Motor C should never be the higher power motor on account of the difference in belt tension in the two belts. True, if the belts are so proportioned that the unit tensions in each are exactly equal, the belt stretch would be the same in each belt, and it would be "nip and tuck" as to which belt should run on the inside or outside. Besides, with motor B being the more powerful it would have a wider belt than motor C



and it would be the "natural thing" to place the wider belt beneath the narrower belt.

This writer believes that where the unit stresses in the two belts are exactly equal there is very little creep, if any, between the rider and inner belts, because the stretching and contraction of the belt fibers are then simultaneous. This is a point that, so far as the writer knows, has never been tested.

W.F.S.

CORRECTION

An unfortunate typographical error in the article "Equipment for High Temperature Testing", which appeared in the February, 1957, issue of RUBBER AGE, transposed the captions for Figures 10 and 11 as they appeared on page 848. The caption for Figure 10 (butyl) should, of course, apply to the graph starting with 1550 psi tensile strength, and Figure 11 (neoprene) should apply to the graph starting with a tensile strength of 3575 psi. We regret the error.

The Compounding of Transparent Rubber

Part II—Styrene-Butadiene, Nitrile, Butyl and Neoprene Rubbers

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Styrene-Butadiene Rubber

PROBLEMS encountered in developing transparent stocks with styrene-butadiene rubbers are entirely different from those met in working with natural rubber, as discussed in Part I of this article. There is no question about what elastomer to use when working with the natural product—the only choice is pale crepe. When working with the synthetics, however, the first question to be answered is that of what polymer to use. Type of acceleration and curing system to use are equally important in both cases. When using synthetics it is not necessary to test carefully many antioxidants and fatty acids as was done with natural rubber. On the other hand, use of synthetics brings up certain new problems such as the effect of coumarone resins on transparency. All of these factors are considered in more detail below.

Type of Rubber: Satisfactory transparent styrene-butadiene rubber compounds can only be made with the non-staining copolymers. Transparent sheets can be made with the staining types, such as GR-S 1000, but they are so dark that they are of little value. Consequently, the first step in developing transparent styrene rubber stocks was to compare a number of the non-staining types. The initial work was done in an MBTS-TMTDS-Glycol accelerated stock cured with 1.75 PHR of sulfur and loaded with 20 volumes of Hi-Sil 233. In this particular recipe, GR-S 1503 and Krylene NS gave the best transparency. These were followed in order by 1502, 1703, 1001 and 1708, all of which were quite poor and would not be considered as giving satisfactory transparent stocks. A similar comparison was made a little later in an MBTS-DOTG-triethanol amine accelerated compound. Again, 1503 and Krylene NS were definitely best, followed by 1502, 1703 and 1001. This initial screening was done in 1955. Recent work indicates that some of the presently available 1502 rubber has very much better color. Therefore, it is suggested that compounders make their own evaluation of the rubbers now on the market.

The 1001, 1502, 1703 and 1708 types of rubbers were dropped from further consideration at this point and for some time all of the effort was concentrated on 1503 and Krylene NS. Continued work on accelerators, which will be discussed subsequently, indicated that improved transparency was obtained with an MBT-DPG-hexamine-glycol combination. The latter two rubbers were tested with this acceleration and two additional rubbers were included in the test. One of these was GR-S 1006 and the other was Plioflex 1778, an oil extended polymer which had just been placed on the market at the time.

The Plioflex 1778 proved to be much more transparent than any of the other three rubbers. This result was unexpected because the two oil extended rubbers which had been tested previously, i.e., 1703 and 1708, had exhibited very poor transparency. The manufacturers of Plioflex 1778 state that it is made with a new, carefully selected naphthenic oil. Although the specifications for this oil have not been made public, it is obvious that the refractive index must be practically identical with that of Hi-Sil 233. In this particular test, 1503 had the next best transparency, closely followed by 1006. Krylene NS also had good transparency although somewhat less than the 1503. These differences are illustrated in Figure 1.

The physical properties exhibited by compounds made with the four different rubbers are shown in Table I. Krylene NS has slightly the best tensile properties but, in other respects 1503 is quite similar to it. 1006 had considerably lower tensile strength in this and in other tests. Since use of 1006 does not appear advantageous in any other respect there is no reason to use it in preference to 1503 or Krylene NS.

Hardness of the Plioflex 1778 compound was consider-

TABLE I—COMPARISON OF PHYSICAL PROPERTIES OF TRANSPARENT COMPOUNDS MADE FROM SEVERAL STYRENE-BUTADIENE RUBBERS

Test Recipe

S-B Rubber	100.00
Hi-Sil 233	39.00
Zinc Oxide	1.00
MBT	0.75
DPG	1.50
Hexamine	1.00
Sulfur	1.75
Diethylene glycol	3.00
Stearic Acid	1.00

Rubber	Mins. Cure at 292°F.	Modulus 300%	Tensile	Elong.	Duro. A Hardness 0″	Duro. A Hardness 30″	Tear lbs./in.	Opacity %
1503	10	530	2540	780	61	48	240	
	15	540	2530	760	63	49	250	
	20	550	2600	770	63	50	250	
	30	530	2680	750	63	49	230	49.9
	45	680	2190	650	63	50	250	
Krylene NS	10	500	2660	780	63	49	250	
	15	480	2800	780	64	50	240	
	20	510	2830	730	64	51	240	
	30	490	2870	750	64	51	230	59.7
	45	500	2770	740	64	51	230	
Plioflex 1778	10	540	2020	680	53	46	170	
	15	560	2060	690	54	47	160	
	20	570	2080	680	55	48	170	
	30	520	2110	690	54	48	180	44.9
	45	550	2120	680	57	49	180	
1006	10	650	1750	610	63	48	200	
	15	610	1920	660	64	48	220	
	20	610	1810	630	63	49	240	
	30	670	1950	630	64	50	230	51.8
	45	710	2000	620	64	51	250	

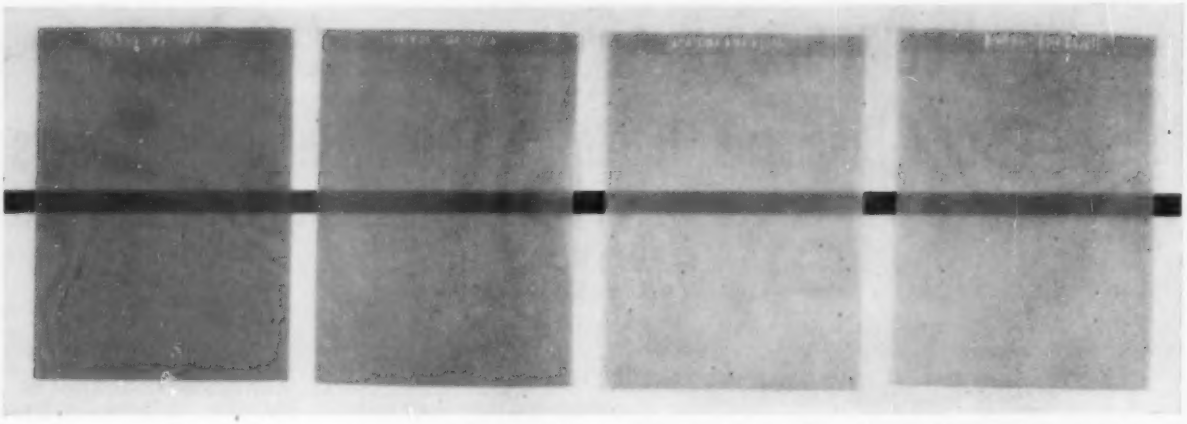


FIG. 1—A comparison of the transparency of four different types of styrene-butadiene rubber loaded with 20 volumes of Hi-Sil 233. From left to right, the sheets are based on: (a) Plioflex 1778; (b) GR-S 1503; (c) GR-S 1006; (d) Krylene NS. Test recipe used appears in Table I.

ably below that of the other rubbers. It was decided, therefore, to see if the Plioflex 1778 would retain its superior transparency when compounded to equal hardness. It was found that 48.75 PHR (25 volumes) of Hi-Sil 233 gave Plioflex 1778 the same hardness that 20 volumes of pigment imparted to 1503 or Krylene NS and that the superior transparency was retained. Additional work was then done to find the upper limit of Hi-Sil 233 loading that the Plioflex 1778 would tolerate without losing transparency. The results obtained were the most astonishing of the entire study. Very highly loaded Plioflex 1778 stocks were made having better transparency than was obtainable with any other type of GR-S or with natural rubber.

Pigment loading was carried up to 97.5 parts of Hi-Sil 233 (50 volumes) per hundred parts of rubber which was the practical limit of pigment which could be mixed into the polymer. Not only was transparency not decreased, but it actually improved with increasing loading. This is clearly shown in Figure 2 which depicts the transparency of Plioflex 1778 sheets containing 20, 30, 40 and 50 volumes of Hi-Sil 233. It will be noted that the black line can be seen more clearly through the 50 volume loaded sheet at the extreme right of the picture than it can through the 20 volume loaded sheet at the left. This is also borne out by the percent opacity data in Table II.

The explanation of this phenomenon is not clear. It has been noticed that the surface of the Plioflex 1778 sheet is not quite as dry as the other rubbers at the 20 volume loading. As the loading increases the surface becomes dryer. The increased loading also makes for better molding and there is less tendency toward orange peeling which was noticed at the lower loads. These are factors which may contribute to the exceptional transparency of the highly loaded sheets.

The physical properties shown in Table II also indicate that transparent shoe soles need not be limited to the soft "crepe" type. If it is desirable, transparent soles can be made with Plioflex 1778 which will approach the so-called nuclear soles in hardness and stiffness. Table II shows that Plioflex 1778 loaded with 40 volumes of Hi-Sil 233 has a Durometer hardness in the middle 80 range. This appears to be the upper desirable limit of loading. This stock, with 40 volumes of pigment, does not turn white when flexed. When the loading is in-

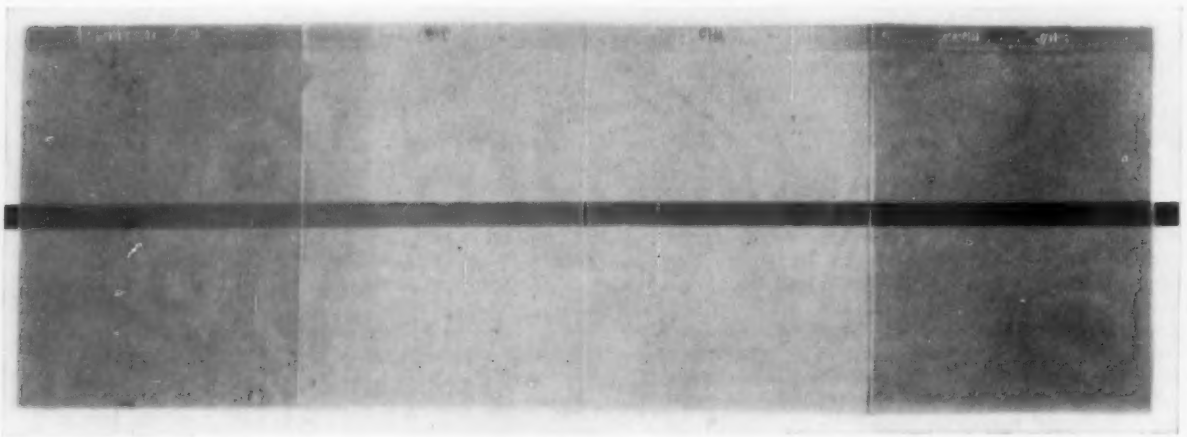


FIG. 2—A comparison of the effect of various Hi-Sil 233 loadings on the transparency of Plioflex 1778 compounds. From left to right, the sheets contain 20, 30, 40 and 50 volumes of pigment. Test recipe for the 20 volume stock appears in Table I and the recipes for the others in Table II.

creased to 50 volumes the stock whitens when flexed which rules it out of most uses even though the hardness has undergone a desirable increase to the middle 90 range.

In summing up this discussion about the most desirable type of styrene-butadiene rubber to use in making transparent compounds, two recommendations are necessary. If the properties obtainable at 20 volume loadings of Hi-Sil 233 are suitable, it is probably best to use 1503 or Krylene NS. These give satisfactory transparency and have better physical properties and a dryer surface feel than Plioflex 1778. There is a noticeable loss in transparency in these rubbers as the Hi-Sil 233 loading is increased above 20 volumes. Therefore if higher loadings than 20 volumes are required to obtain the modulus, hardness and tear resistance desired, it will be necessary to use Plioflex 1778.

Vulcanizing Agent: The superiority of a combination of 1 PHR of sulfur with 1 PHR of Sulfasan R over 1.75 PHR of sulfur alone as a vulcanizing agent for natural rubber compounds was clearly shown in Part I of this article. No such superiority was found to exist in the case of transparent compounds made from the styrene-butadiene rubbers. In fact, just the reverse was true. Stocks cured with 1.75 PHR of sulfur alone had equal transparency and much better physical properties than those cured with sulfur-Sulfasan R or VA-7. This point was checked carefully using a variety of combinations because of the remarkable improvement which the sulfur-organic sulfide curing system had brought about in natural rubber. It was not found possible to obtain anything like the same results in general purpose synthetic rubber, however.

The sulfur-Sulfasan R combination was tested, for example, in a 1503 compound accelerated with MBTS-DOTG-triethanol amine. It gave a very slow rate of cure compared with a 1.75 PHR sulfur cured stock and tensile, modulus and tear were all distinctly poorer. The same was true with MBTS-DPG-hexamine-Diethylene glycol acceleration as is shown in Table III. Similar results were obtained in another 1503 compound accelerated with MBTS-TMTDS-diethylene glycol. Again, the sulfur-Sulfasan R stock was very slow curing and had lower modulus and tear resistance although it did eventually reach the same level of tensile strength.

The sulfur-Sulfasan R combination gave its best per-

TABLE II—EFFECT OF INCREASED HI-SIL 233 LOADING IN TRANSPARENT PLIOFLEX 1778 COMPOUNDS

Test Recipes

	II-A	II-B
Plioflex 1778	100.00	100.00
Hi-Sil 233	As Shown	As Shown
Zinc Oxide	1.00	1.00
Zenite	0.75	0.90
DPG	1.50	1.80
Hexamine	1.00	1.20
Sulfur	1.75	1.75
Diethylene Glycol	3.00	3.00
Stearic Acid	1.00	1.00

Hi-Sil 233 Loading	Test Recipe	Mins. Cure at 292°F.	Modulus 300%	Tensile	Elong.	Duro. A Hardness 0"	Duro. A Hardness 30"	Tear lbs./in.	Opacity %
48.75 PHR (25 vols.)	II-A	10	710	1880	620	60	50	250	
		15	720	1890	620	60	51	220	
		20	730	2070	630	63	53	220	
		30	720	2080	640	64	55	230	40.9
		45	820	2040	590	65	55	250	
58.5 PHR (30 vols.)	II-A	10	860	1970	600	68	58	300	
		15	880	2070	600	69	59	290	
		20	880	2180	600	70	60	320	
		30	890	2220	600	71	60	300	40.7
		45	970	2190	570	73	64	320	
68.25 PHR (35 vols.)	II-A	10	1130	2050	560	74	65	330	
		15	1170	2250	560	76	68	340	
		20	1100	2270	580	78	69	360	
		30	1100	2400	600	80	72	370	34.4
		45	1180	2400	580	83	74	340	
78 PHR (40 vols.)	II-B	10	1440	2290	560	80	72	440	
		20	1620	2300	470	83	77	430	
		30	1680	2310	460	83	77	410	25.0
		45	1750	2320	440	87	80	410	
		60	1860	2350	420	88	81	420	
97.5 PHR (50 vols.)	II-B	10	1510	2000	520	92	88	400	
		20	1590	1980	470	94	90	400	
		30	1560	1970	470	93	90	340	24.6
		45	1560	1960	470	95	92	310	
		60	1570	1860	410	94	92	290	

TABLE III—COMPARISON OF PHYSICAL PROPERTIES OF TRANSPARENT STYRENE-BUTADIENE RUBBER COMPOUNDS VULCANIZED WITH SULFUR AND WITH SULFUR-ORGANIC SULFIDE COMBINATIONS

Test Recipes

III-A

GR-S 1503	100.00
Hi-Sil 233	39.00
Zinc Oxide	1.00
MBTS	0.75
DPG	1.50
Hexamine	1.00
Diethylene Glycol	3.00
Vulcanizing Agents	As Shown
100°C. m.p. coumarone resin	5.00
Stearic Acid	1.00

III-B

GR-S 1503	100.00
Hi-Sil 233	39.00
Zinc Oxide	1.00
MBTS	1.00
Me. Zimate	0.25
Hexamine	1.00
Diethylene Glycol	3.00
Vulcanizing Agents	As Shown
100°C. m.p. coumarone resin	5.00
Stearic Acid	1.00

Test Recipe	Vulcanizing Agent	Mins. Cure at 292°F.	Modulus 300%	Tensile	Elong.	Duro. A Hardness 0"	Duro. A Hardness 30"	Tear lbs./in.
III-A	S 1.75	10	320	2440	830	57	44	240
		15	330	2800	840	56	43	250
		20	360	2790	810	57	44	260
		30	350	2770	810	58	46	250
		45	360	2930	810	58	45	250
III-A	S 1 Sulfasan R 1	20	—	1290	1120	56	40	210
		30	220	2120	1100	57	42	220
		45	240	2390	960	59	42	210
		60	250	2220	920	61	46	210
III-B	S 1.75	10	420	2880	800	60	49	240
		15	430	2940	790	60	49	230
		20	470	2880	760	60	49	260
		30	450	2860	760	61	50	240
		45	450	2740	760	62	50	240
III-B	S 1 Sulfasan R 1	15	360	2830	830	57	47	190
		20	380	2850	790	57	47	180
		30	370	2870	790	58	47	180
		45	330	2710	790	58	47	170

TABLE IV—COMPARISON OF FOUR THIAZOLES IN THIAZOLE - GUANIDINE - AMINE - GLYCOL ACCELERATION OF TRANSPARENT STYRENE-BUTADIENE RUBBER COMPOUNDS

Test Recipe

GR-S 1503	100.00
Hi-Sil 233	39.00
Zinc Oxide	1.00
Thiazole	0.75
DPG	1.50
Hexamine	1.00
Diethylene Glycol	3.00
Sulfur	1.75
Stearic Acid	1.00

Thiazole	Mins. Cure at 292°F.	Modulus 300%	Tensile	Elong.	Duro. A Hardness 0″	Duro. A Hardness 30″	Tear lbs./in.	Opacity %
Zenite	10	490	2490	770	57	47	260	
	15	480	2900	800	58	48	240	
	20	490	2870	790	58	48	260	
	30	500	2860	770	62	52	260	48.5
	45	570	2840	730	62	52	230	
	60	580	2810	740	62	51	250	
MBT	10	520	2520	770	56	46	250	
	15	520	2760	770	58	48	240	
	20	500	2600	740	58	48	260	
	30	560	2670	740	62	51	240	54.3
	45	550	2740	730	62	52	250	
	60	630	2410	670	62	52	240	
MBTS	10	370	2700	820	57	47	230	
	15	420	2770	790	57	47	220	
	20	440	2830	790	57	47	210	
	30	420	2770	770	59	51	220	62.8
	45	450	2760	760	62	52	220	
	60	440	2930	760	62	52	230	
Santocure	10	320	2410	880	56	44	220	
	15	330	2540	860	56	45	230	
	20	360	2530	840	56	46	220	
	30	360	2710	830	58	48	210	63.0
	45	370	2770	810	58	47	220	
	60	390	2780	790	58	48	230	

formance in 1503 in a compound which was accelerated with MBTS-Methyl Zimate-hexamine-diethylene glycol. This comparison is also shown in Table III. Rate of cure was about equal to that of a straight sulfur compound and physical properties were quite similar excepting for tear resistance which was poorer. Transparency was not improved. Since the sulfur-sulfide curing system is more expensive than sulfur alone, there was nothing to recommend its use in this instance. Sulfasan R showed no advantage in two other rubbers in which it was tested, 1703 and 1502.

A slight amount of work was done with VA-7 as a partial and total replacement for sulfur in Krylene NS stocks accelerated in one case with MBTS-TMTDS-diethylene glycol and in another case with a Santocure-TMTDS-glycol-triethanol amine combination which has been recommended in the literature *(1)*. In the first case, replacement of half of the 1.75 PHR of elemental sulfur originally present with 1.5 of VA-7 did not alter rate of cure, transparency or physical properties. Replacement of all of the sulfur by 3 PHR of VA-7 decreased all physical properties although it did not change the rate of cure. In the other recipes replacement of half of the original 3 PHR of sulfur with 1.5 PHR of VA-7 gave slightly better physical properties. Replacement of all of the sulfur with 3 PHR of VA-7 halved the modulus and reduced tensile but gave improved tear. No further work was carried out with VA-7 because of the odor problem mentioned earlier.

As was done with natural rubber, attempts were made to replace sulfur with an oxidizing agent, dicumyl peroxide (Di-Cup). Good cures were obtained with 1.75 PHR of this agent both in 1503 and Krylene NS at loadings of either 20 volumes or 30 volumes of Hi-Sil 233. The compounds contained nothing else besides the polymer, pigment and peroxide and it was thought that curing without zinc oxide or sulfur would result in excellent transparency. This was not the case, however, as the sheets were translucent rather than transparent. The physical properties of the compounds also fell off badly with overcure. Tensile sheets cracked badly when bent double after eight months outdoor exposure.

Acceleration: Accelerator combinations which were best for transparent natural rubber stocks did not prove to be the best for the styrene-butadiene rubbers. In the former, thiazole-dithiocarbamate-amine cured stocks were lighter and more satisfactory than thiazole-guanidine-amine compounds but the reverse was true in the case of the general purpose synthetic rubber. In the latter, thiazole-guanidine-amine combinations were definitely best. Also, diethylene glycol which was not found to be necessary in the natural rubber stocks proved to be of benefit as an added activator in the synthetics.

TABLE V—COMPARISON OF FOUR THIAZOLES IN THIAZOLE-DITHIOCARBAMATE-AMINE-GLYCOL ACCELERATION OF TRANSPARENT STYRENE-BUTADIENE RUBBER COMPOUNDS

Test Recipe

GR-S 1503	100.00
Hi-Sil 233	39.00
Zinc Oxide	1.00
Thiazole	1.00
Methyl Zimate	0.25
Hexamine	1.00
Diethylene Glycol	3.00
Sulfur	1.75
Stearic Acid	1.00

Thiazole	Mins. Cure at 292°F.	Modulus 300%	Tensile	Elong.	Duro. A Hardness 0″	Duro. A Hardness 30″	Tear lbs./in.	Opacity %
Zenite	10	500	2300	790	58	48	260	
	15	500	2370	790	60	47	250	
	20	470	2490	810	60	47	250	
	30	470	2610	810	60	47	260	55.6
	45	480	2530	790	60	49	270	
	60	470	2540	800	60	48	250	
MBT	10	540	2310	760	58	48	210	
	15	560	2330	770	60	48	240	
	20	580	2300	740	60	48	230	
	30	580	2340	720	61	50	240	56.4
	45	550	2380	760	61	50	240	
	60	500	2360	760	61	48	220	
MBTS	10	470	3000	800	62	52	220	
	15	490	3070	790	62	52	220	
	20	530	2970	760	62	52	240	
	30	500	2910	770	62	52	230	60.8
	45	510	2920	770	62	52	240	
	60	480	2960	770	62	52	230	
Santocure	10	320	2780	910	58	47	220	
	15	350	2800	870	60	48	220	
	20	330	2790	870	60	48	230	
	30	360	2810	840	60	48	220	62.5
	45	370	2800	850	60	48	210	
	60	350	2680	840	60	48	220	

Specifically, the preferred accelerator combinations for transparent styrene-butadiene compounds consist of Zenite, MBT, Santocure or MBTS plus DPG plus hexamethylene tetramine plus diethylene glycol. The results obtained with these four different thiazoles in this type of accelerator combination are shown in Table IV. The Zenite and MBT stocks were the lightest of the four. The Zenite compound also had slightly better physical properties than the others and for these reasons it is the best choice of the thiazoles tested. DPG is used instead of DOTG because it gives slightly better transparency.

When the same four thiazoles were tested in combination with Methyl Zimate, hexamine and glycol the resulting stocks were all somewhat darker and less transparent. In this group, MBTS and Santocure gave slightly better tensiles but there was little difference in tear resistance. The results are shown in Table V. It will be noted that hexamine is shown in both accelerator combinations above. As in the case of natural rubber, it proved to be a definite aid to transparency. Diethylene glycol, in addition to the amine, proved useful in the synthetic stocks although unnecessary in natural rubber. Its presence speeded up the rate of cure.

The same four thiazoles were also tested in combination with TMTDS and glycol. In every case, transparency and physical properties were poorer than with the guanidine or dithiocarbamate. A combination giving good physical properties consisted of 1.5 PHR of Tetrone A plus 1 of hexamine and 3 of diethylene glycol. Transparency was not as good as that of either of the thiazole combinations.

Zinc Oxide: Since seven different fine particle zinc oxides had given equivalent results in natural rubber, no extensive test was carried out in the styrene-butadiene rubbers. Zinc carbonate, which would not disperse in natural rubber, was found to disperse satisfactorily when mixed in GR-S 1503. A stock containing 1.5 PHR of the carbonate has poorer physical properties than a similar one containing 1 PHR of zinc oxide. Increasing the carbonate to 4 PHR gave equal properties and good transparency.

Coumarone Resin: A coumarone-indene resin derived from coal tar was included in all of the early compounding work on transparent styrene-butadiene stocks. Since pigment loadings in this early work were relatively low it was decided to see if omission of the resin would improve transparency without affecting physical properties seriously. The effect of coumarone resin on GR-S 1503 stocks cured with two different acceleration systems is shown in Table VI. Omission of the resin resulted in both cases in slightly higher modulus and hardness and slightly lower elongation but had little effect on tensile strength or tear resistance. In fact, tensile and tear of the resin free stocks were perhaps slightly better than of those containing resin.

Of the two compounds shown cured with an MBTS-DPG-Hexamine-glycol combination the one which did not contain resin was slightly lighter and more transparent than the one containing 5 PHR of coumarone. In the case of the two cured with MBTS-TMTDS-glycol there was no difference in transparency whether coumarone resin was present or not.

Different brands of coumarone resins are made from different raw materials, some being derived from coal tar, others from naphthenic petroleum oil fractions, and others from combinations of the two. Certain petroleum resins which are not even polymers of coumarone and indene are sold for the same purposes as the coumarone resins. Effect of these different resins on transparency has not been studied but it is reasonable to expect that there might be variation. For this reason, and because inclusion of the resin appears to offer no particular advantage at lower loadings, the omission of such resins from the lower hardness transparent styrene-butadiene compounds is indicated.

It was mentioned earlier that much higher loadings of Hi-Sil 233 can be used in Plioflex 1778 than in GR-S 1503 and that this fact might make it possible to produce transparent soles approaching more closely the so-called nuclear soles in hardness and stiffness. This fact also made it necessary to examine the effect of the coumarone resins on more highly loaded compounds even though these resins had been shown to be of no value at lower loadings.

Inclusion of 5 parts of resin in the more highly loaded stocks again had little effect on tensile strength, tear resistance, modulus or elongation. It did reduce abrasion resistance slightly which is undesirable. Addition of resin improved the flex resistance of the compound more than enough to outweigh the lessened abrasion resistance,

TABLE VI—EFFECT OF COUMARONE RESIN ON PHYSICAL PROPERTIES OF TRANSPARENT STYRENE-BUTADIENE RUBBER COMPOUNDS

Test Recipe
VI-A

GR-S 1503	100.00
Hi-Sil 233	39.00
Zinc Oxide	1.00
MBTS	0.75
DPG	1.50
Hexamine	1.00
Diethylene Glycol	3.00
Sulfur	1.75
Stearic Acid	1.00
100°C. m.p. Coumarone Resin	As Shown

VI-B

GR-S 1503	100.00
Hi-Sil 233	39.00
Zinc Oxide	1.00
MBTS	1.20
TMTDS	0.15
Diethylene Glycol	3.00
Sulfur	1.75
100°C. m.p. Coumarone Resin	As Shown

Compound	Coumarone Resin PHR	Mins. Cure at 292°F.	Modulus 300%	Tensile	Elong.	Duro. A Hardness 0"	Duro. A Hardness 30"	Tear lbs./in.
VI-A	0	10	320	2710	810	59	47	270
		15	330	2800	840	57	44	250
		20	390	2810	780	61	49	260
		30	450	2850	730	62	49	280
		45	380	2890	760	63	50	260
VI-A	5	10	320	2440	830	57	44	240
		15	330	2800	840	57	44	250
		20	360	2790	810	57	44	260
		30	350	2770	810	58	46	250
		45	360	2930	810	58	45	250
VI-B	0	10	500	2750	820	62	49	220
		15	500	2910	770	60	48	200
		20	500	2890	750	61	49	200
		30	500	2830	740	61	50	180
		45	500	2820	750	60	50	170
VI-B	5	10	450	2730	830	57	47	200
		15	430	2820	800	58	47	200
		20	470	2810	780	60	48	190
		30	480	2800	760	60	48	180
		45	410	2820	790	60	47	170

TABLE VI-A—EFFECT OF COUMARONE RESIN ON PHYSICAL PROPERTIES OF A HIGHLY LOADED TRANSPARENT PLIOFLEX 1778 COMPOUND

Test Recipe

Plioflex 1778	100.00
Hi-Sil 233	68.25
Zinc Oxide	1.00
Zenite	0.90
DPG	1.80
Hexamine	1.20
Diethylene Glycol	3.00
Sulfur	1.75
Stearic Acid	1.00
100°C. m.p. Coumarone Resin	As Shown

Coumarone Resin PHR	Mins. Cure at 292°F.	Modulus 300%	Tensile	Elong.	Duro. A Hardness 0″	30″	Tear lbs./in.
0	7.5	1180	2550	620	75	65	370
	10.0	1220	2560	610	76	64	360
	15.0	1230	2580	600	78	67	370
	20.0	1280	2530	590	80	70	380
	30.0	1220	2440	560	80	70	360
5	7.5	980	2180	650	75	64	370
	10.0	1130	2370	630	75	65	420
	15.0	1240	2440	610	78	66	360
	20.0	1270	2460	590	79	68	350
	30.0	1260	2460	590	80	70	350

Abrasion Resistance
(NBS Abrader. Per Cent of Control B)

Coumarone Resin PHR	Cure at 292°F.	Unaged Sample	Aged 24 hrs. at 212°F.
0	20	79.5	76.5
5	20	71.4	72.5

Flexing Resistance
(Ross Flexes. Length of Break in Inches)

Coumarone Resin, PHR	Cure at 292°F.	Unaged Sample, After Flexing: 20,000	50,000	100,000	Sample Aged 24 hours at 212°F. After Flexing: 20,000	50,000	100,000
0	20	.34	.59	.92	.46	.79	Comp.
5	20	.23	.41	.63	.41	.61	.90

however. These results are shown in Table VI-A. It appears, therefore, that addition of five parts of coumarone resin is desirable in transparent synthetic rubber compounds containing high loadings of Hi-Sil 233 if flex resistance is a service requirement.

Fatty Acid: It was evident from the work with natural rubber that there was considerable latitude in the type of fatty acid chosen for transparent stocks. Consequently, no extensive work was done to test various fatty acids in styrene-butadiene rubber. Inclusion of 1 PHR of stearic acid did not decrease transparency in any case and in some instances it did appear to help tear resistance. Therefore, one part of this fatty acid has been included in the suggested recipes.

Comparison of Pigments: Eleven different silicas and silicates were tested for their effect on transparency of Plioflex 1778 and GR-S 1503. As was the case in natural rubber, Hi-Sil 233, Hi-Sil X303, Vulkasil S 579/1 and Ultrasil VN3 were the only four pigments that needed to be given consideration for use in transparent compounds made from these two styrene-butadiene copolymers. The transparency ratings of the various pigments in the two types of rubber are shown in Table VII and the physical properties of the four best pigments are given in Table VIII.

Hi-Sil X303 was slightly better than 233 in transparency and definitely better in regard to physical properties. As stated earlier, the advantages again will not justify the use of the more expensive X303 in most cases. Hi-Sil 233 and Vulkasil S 579/1 gave properties that were quite similar and both were somewhat better than Ultrasil VN-3. The differences in transparency caused by the pigments listed in Table VII are clearly illustrated in Figures 3 and 4 which show Plioflex and 1503 compounds respectively.

Temperature of Cure: A comparison was made between tensile sheets of a transparent Plioflex 1778 compound cured at 270°F. and at 320°F. A similar comparison was made using GR-S 1503. In both cases, the sheets cured at the lower temperature were slightly lighter in color and slightly more transparent than those cured at the 50° higher temperature. The Plioflex sheets, at both temperatures, were much more transparent than the GR-S 1503 compounds even though they contained a fifty per cent higher loading. A brief comparison of properties obtained with both copolymers at the two curing temperatures is given in Table IX.

Nitrile Rubber

Compounds having very satisfactory transparency have been made from Hi-Sil 233 loaded nitrile rubber. Only a small amount of development work was done with this copolymer because the possible applications for transparent nitrile rubber stocks appeared to be limited. The amount of work was very much less than in the case of natural rubber or of the styrene-butadiene rubbers.

A comparison was made, first of all, of the effect of three different curing systems on the transparency of a high acrylonitrile content copolymer, Hycar 1001, loaded with 20 volumes of Hi-Sil 233. The comparison included a conventional sulfur cured compound, a TMTDS cured compound and a dicumyl peroxide (Di-Cup) cured stock. The compound which contained elemental sulfur was much darker and less transparent than either of the

TABLE VII—COMPARISON OF OPACITY OF STYRENE-BUTADIENE RUBBER COMPOUNDS CONTAINING VARIOUS SILICA AND SILICATE PIGMENTS

Test Recipes

VII-A		VII-B	
Plioflex 1778	100.00	GR-S 1503	100.00
Pigment	58.50	Pigment	39.00
Zinc Oxide	1.00	Zinc Oxide	1.00
Zenite	0.75	Zenite	0.75
DPG	1.50	DPG	1.50
Hexamine	1.00	Hexamine	1.00
Diethylene glycol	3.00	Diethylene glycol	3.00
Sulfur	1.75	Sulfur	1.75
Stearic Acid	1.00	Stearic Acid	1.00

Cures: 30′ at 292°F.

Pigment (VII-A)	Opacity, %	Pigment (VII-B)	Opacity, %
Hi-Sil X303	29.1	Hi-Sil X303	53.8
Hi-Sil 233	31.4	Hi-Sil 233	56.9
Vulkasil S 579/1	42.7	Vulkasil S 579/1	58.0
Ultrasil VN3	66.9	Ultrasil VN3	71.1
Silene EF	70.8	Silene EF	80.2
Vulkasil S	72.8	Vulkasil C	82.7
Silteg AS-5	79.2	Vulkasil S	83.6
Vulkasil C	81.0	Silteg AS-5	84.3
Hi-Sil 101	90.9	Hi-Sil 101	90.7
Fransil 251	91.2	Zeolex 23	90.9
Zeolex 23	92.0	Fransil 251	96.7

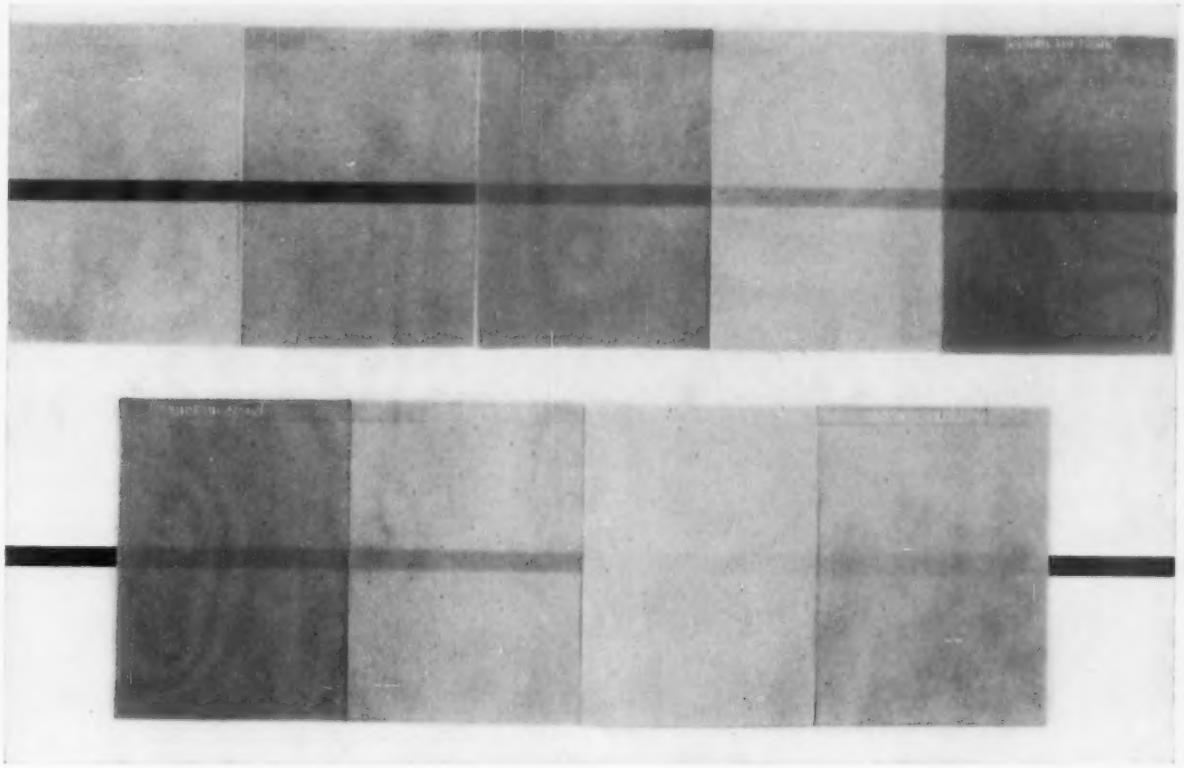


FIG. 3—A comparison of the transparency of Plioflex 1778 compounds containing various silica and silicate pigments. The tensile sheets shown above contain 30 volumes of the following pigments: Top row, left to right: Hi-Sil X303, Hi-Sil 233 Ultrasil VN-3, Vulkasil S, Silene EF. Bottom row, left to right: Silteg AS-5, Vulkasil C, Hi-Sil 101, Zeolex 23. Test recipe used appears in Table VII.

other two. The TMTDS cured compound and the peroxide cured stock both had fairly good transparency. Next, comparisons were made between several different types of Hycar cured by the two latter methods.

When a TMTDS curing system was used, Hycar 1432 gave the lightest and most transparent compound. A Hycar 1041 stock had nearly the same transparency but was slightly darker. Hycar 1043 was slightly less transparent than 1041. Compared with any of these three, Hycars 1001 and 1002 were quite unsatisfactory. The physical properties of these compounds are given in Table X. Figure 5 shows rather clearly the differences in transparency of these different grades of nitrile copolymer. The black line can be seen most clearly through the Hycar 1432 and 1041 samples in the upper left and upper center of the photograph. The 1043 sheet at the upper right is less clear. The 1001 samples and the 1002 sample at the bottom of the illustration are obviously much less transparent.

The differences in transparency of Hi-Sil 233 loaded, TMTDS cured Hycars apparently are not related to the acrylonitrile content of the copolymer. 1432 is classed as a medium acrylo content rubber; 1041 as high; 1043 as medium low; 1001 as high; and 1002 as medium. Some other variable in the composition or method of manufacture of this family of nitrile rubbers must be responsible for the differences in transparency.

When a Di-Cup curing system was used, Hycar 1043 gave the lightest and most transparent stock, closely followed by 1432 and 1002. Compounds made with 1041 and 1001 were quite dark although it was still possible to read through the thickness of a tensile sheet. The physical properties of the five compounds are shown in Table XI.

The TMTDS curing system gave lighter and more transparent stocks than Di-Cup in the case of Hycars 1432, 1041 and 1043. Hycar 1041, in particular, was much lighter when cured with TMTDS. The Di-Cup curing system gave a much lighter and more transparent compound than TMTDS in the case of Hycar 1002 and a somewhat lighter and more transparent compound with Hycar 1001. In regard to physical properties, TMTDS gave better results than Di-Cup in the case of 1002 and 1041; while Di-Cup gave the higher properties in the case of 1043, 1432 and 1001. It should be pointed out that the Di-Cup recipe used does not appear to be a good one for 1002 because the results indicate overcure. Unlike the Di-Cup cured GR-S stocks, all of the Di-Cup cured nitrile compounds were in excellent condition after eight months outdoor exposure. Considering all properties—transparency, lightness of color, and physical strength—the best all around combination is given by the Hycar 1432 compound cured with TMTDS.

In this investigation, the Hycars were the only nitrile copolymers evaluated. There is no intention to imply that they are the only ones that will give transparent compounds. Some of the types made of the three other major manufacturers will undoubtedly give good transparency and, perhaps, may be even superior to those reported here. Obviously, it would be necessary to test each individual grade for its value in transparent compounds because this property is affected by so many factors.

Table VIII—Comparison of Four Silica Pigments in Transparent Styrene-Butadiene Rubber Compounds

Test Recipes

VIII-A		VIII-B	
Plioflex 1778	100.00	GR-S 1503	100.00
Pigment	58.50	Pigment	39.00
Zinc Oxide	1.00	Zinc Oxide	1.00
Zenite	0.75	Zenite	0.75
DPG	1.50	DPG	1.50
Hexamine	1.00	Hexamine	1.00
Diethylene Glycol	3.00	Diethylene Glycol	3.00
Sulfur	1.75	Sulfur	1.75
Stearic Acid	1.00	Stearic Acid	1.00

Compound VIII-A—30 Volumes of Pigment in Plioflex 1778

Silica	Mins. Cure at 292°F.	Modulus 300%	Tensile	Elong.	Duro. A Hardness 0″	Duro. A Hardness 30″	Tear lbs./in.	Opacity %
Hi-Sil X303	10	1310	2600	610	65	59	360	
	15	1350	2650	600	68	62	380	
	20	1290	2810	610	72	63	360	
	30	1320	2850	590	74	66	350	29.1
	45	1380	2870	600	75	66	360	
Hi-Sil 233	10	940	2260	630	67	56	330	
	15	970	2400	620	67	58	330	
	20	940	2470	620	68	59	320	
	30	900	2580	650	72	61	310	31.4
	45	1050	2470	600	72	62	320	
Vulkasil S 579/1	10	1060	2600	630	64	52	280	
	15	1180	2640	610	66	56	290	
	20	1230	2660	610	68	58	290	
	30	1280	2570	550	70	60	290	42.7
	45	1270	2500	580	70	60	290	
Ultrasil VN-3	10	820	2000	580	62	52	240	
	15	830	1930	570	62	53	240	
	20	860	1950	570	63	54	240	
	30	920	1990	540	64	56	230	66.9
	45	980	1950	520	66	57	220	

Compound VIII-B—20 Volumes of Pigment in GR-S 1503

Silica	Mins. Cure at 292°F.	Modulus 300%	Tensile	Elong.	Duro. A Hardness 0″	Duro. A Hardness 30″	Tear lbs./in.	Opacity %
Hi-Sil X303	10	560	3060	790	65	51	320	
	15	580	2980	760	65	51	330	
	20	620	3010	750	65	52	310	
	30	570	3040	760	66	53	320	53.8
	45	570	2890	740	68	55	330	
Hi-Sil 233	10	500	2520	760	65	51	280	
	15	560	2490	710	65	51	270	
	20	500	2520	740	65	51	280	
	30	520	2540	730	65	51	280	56.9
	45	550	2880	730	65	52	290	
Vulkasil S 579/1	10	440	3260	820	56	46	300	
	15	550	3360	800	56	46	280	
	20	600	3160	760	56	46	280	
	30	580	3350	760	56	46	280	58.0
Ultrasil VN-3	10	600	2140	640	60	47	250	
	15	640	1990	630	60	48	230	
	20	630	2010	630	60	48	240	
	30	750	2170	620	60	48	240	71.1
	45	680	1920	600	60	48	230	

Table IX—Effect of Curing Temperature on Properties of Transparent Styrene-Butadiene Rubber Compounds

Test Recipes

IX-A		IX-B	
Plioflex 1778	100.00	GR-S 1503	100.00
Hi-Sil 233	58.50	Hi-Sil 233	39.00
Zinc Oxide	1.00	Zinc Oxide	1.00
Zenite	0.75	Zenite	0.75
DPG	1.50	DPG	1.50
Hexamine	1.00	Hexamine	1.00
Diethylene Glycol	3.00	Diethylene Glycol	3.00
Sulfur	1.75	Sulfur	1.75
Stearic Acid	1.00	Stearic Acid	1.00

Compound	Cure	Modulus 300%	Tensile	Elong.	Duro. A Hardness 0″	Duro. A Hardness 30″	Tear lbs./in.	Opacity %
IX-A	50′ x 270°F.	840	2280	640	73	63	330	28.9
	75′ "	910	2330	630	73	64	330	29.5
	100′ "	960	2370	610	74	66	350	26.3
	4′ x 320°F.	840	2090	630	67	57	320	30.3
	9′ "	830	2250	630	67	57	350	31.2
	14′ "	900	2270	600	72	62	340	32.3
IX-B	50′ x 270°F.	550	2450	720	63	52	270	46.6
	75′ "	600	2520	670	64	52	290	47.2
	100′ "	600	2630	720	63	52	280	42.9
	4′ x 320°F.	500	2180	710	60	47	270	48.7
	9′ "	540	2370	710	60	48	290	48.6
	14′ "	520	2340	720	61	48	280	52.3

Table X—Comparison of Physical Properties and Opacity of Transparent Nitrile Rubbers Cured with TMTDS

Test Recipe

Hycar	100.00
Hi-Sil 233	39.00
Zinc Oxide	1.00
TMTDS	2.75
Santocure	1.50
Stearic Acid	1.00

Type of Hycar	Mins. Cure at 310°F.	Modulus 300%	Tensile	Elong.	Duro. Hardness 0″	Duro. Hardness 30″	Tear lbs./in.	Opacity %
1432	10	840	3630	700	72	61	400	
	20	1040	3560	650	74	63	410	
	30	1000	3500	650	76	63	420	
	45	1020	3570	640	76	64	420	35.2
	60	970	3670	660	76	64	400	
1041	10	580	3530	770	70	52	310	
	20	590	3570	740	71	54	320	
	30	680	3400	720	71	55	330	
	45	640	3400	710	71	54	310	36.0
	60	650	3410	710	71	55	330	
1043	10	590	2630	750	66	52	280	
	20	560	2640	750	66	52	300	
	30	680	2580	690	66	54	290	
	45	700	2520	690	68	54	300	41.8
	60	650	2750	700	68	54	300	
1001	10	880	3230	680	71	58	290	
	20	960	3420	640	73	59	290	
	30	1010	3500	640	73	58	280	
	45	1010	3520	630	73	59	280	Too Dark
1002	10	960	2650	620	71	58	270	
	20	1000	2640	620	71	60	250	
	30	1040	2730	610	72	61	240	
	45	1080	2730	600	74	62	250	Too Dark
	60	1030	3020	630	74	64	250	

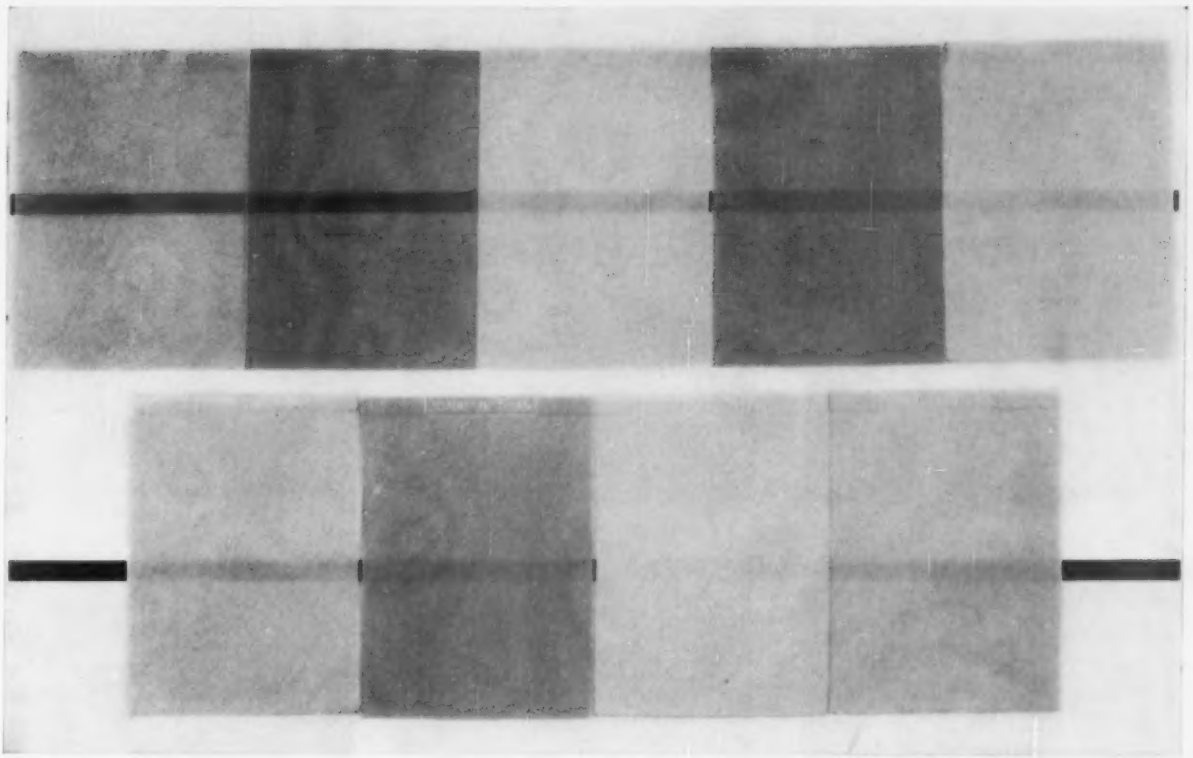


FIG. 4—A comparison of the transparency of GR-S 1503 compounds containing various silica and silicate pigments. The tensile sheets shown above contain 20 volumes of the following pigments: Top row, left to right: Hi-Sil X303, Hi-Sil 233, Ultrasil VN-3, Silene EF, Vulkasil C. Bottom row, left to right: Vulkasil S, Silteg AS-5, Hi-Sil 101, Zeolex 23. Test recipe used appears in Table VII.

Butyl Rubber

Transparent sheets can be made from properly compounded butyl rubber loaded with reinforcing silica. Butyl is not a particularly good material to use for transparent stocks, however, because even the best compounds are much less transparent than those that can be made with natural rubber, styrene-butadiene rubbers or nitrile copolymers. Although Butyl 268 was the only type tested in this work, there is no reason to expect that other grades would be more suitable.

The two butyl stocks with the best transparency that were obtained in this work were the two based on recipes A and C in Table XII. Physically, A was the better of the two stocks but its transparency was poorer than that of C. In neither case, was transparency particularly good. Some of the factors that were checked in developing these transparent compounds are described in more detail below.

Reduction of Sulfur: Elemental sulfur contributes greatly to the opacity of butyl rubber compounds. A stock containing 20 PHR of Hi-Sil 233, 1 PHR of zinc oxide, 2 PHR of TMTDS and no stearic acid, was opaque when vulcanized with 2 PHR of sulfur at all cure times through 60 minutes.

Use of a combination of elemental sulfur with an organic sulfide such as dithiodimorpholine (Sulfasan R), which was disclosed first by this laboratory as a means of producing non-blooming butyl compounds *(2)*, resulted in definite improvement in transparency. Replacement of the 2 PHR of sulfur with a combination of 1 PHR sulfur and 1.5 PHR of Sulfasan R resulted in a stock that was translucent when cured *60'* at 320°F. This translucency was visibly increased by substitution of another organic sulfide, Thiokol's VA-7, for the Sulfasan R. Unfortunately, the VA-7 imparts a characteristic odor that would be objectionable in some potential applications.

Importance of Fatty Acid: The fact that the compounds mentioned above became translucent only after a *60'* cure indicated that some material present was disappearing into the butyl when given sufficient time. It was logical to suspect either the zinc oxide or the TMTDS. Addition of 1 PHR of stearic acid to the sulfur-Sulfasan R cured compounds produced good translucency in a 15 minute cure and transparency at 20 minutes. Otherwise, physical properties and rate of cure of the two stocks were almost identical. This indicates that the transparency was not a matter of the state of cure of the compound but was due to the solubilizing of opaque zinc oxide.

This naturally led to a test of zinc stearate as a replacement for zinc oxide. Use of the metallic soap proved beneficial under some conditions and detrimental under others. Therefore no definite rule can be stated for its use. Replacement of one part of zinc oxide with three or six parts of zinc stearate resulted in a slight darkening and decreased transparency in compounds loaded with 39 PHR of Hi-Sil 233, accelerated with 2 PHR of either TMTDS, or Methyl Zimate, and vulcanized with a sulfur-Sulfasan R combination. A similar replacement of zinc oxide with zinc stearate in compounds vulcanized with three parts of VA-7 and no free

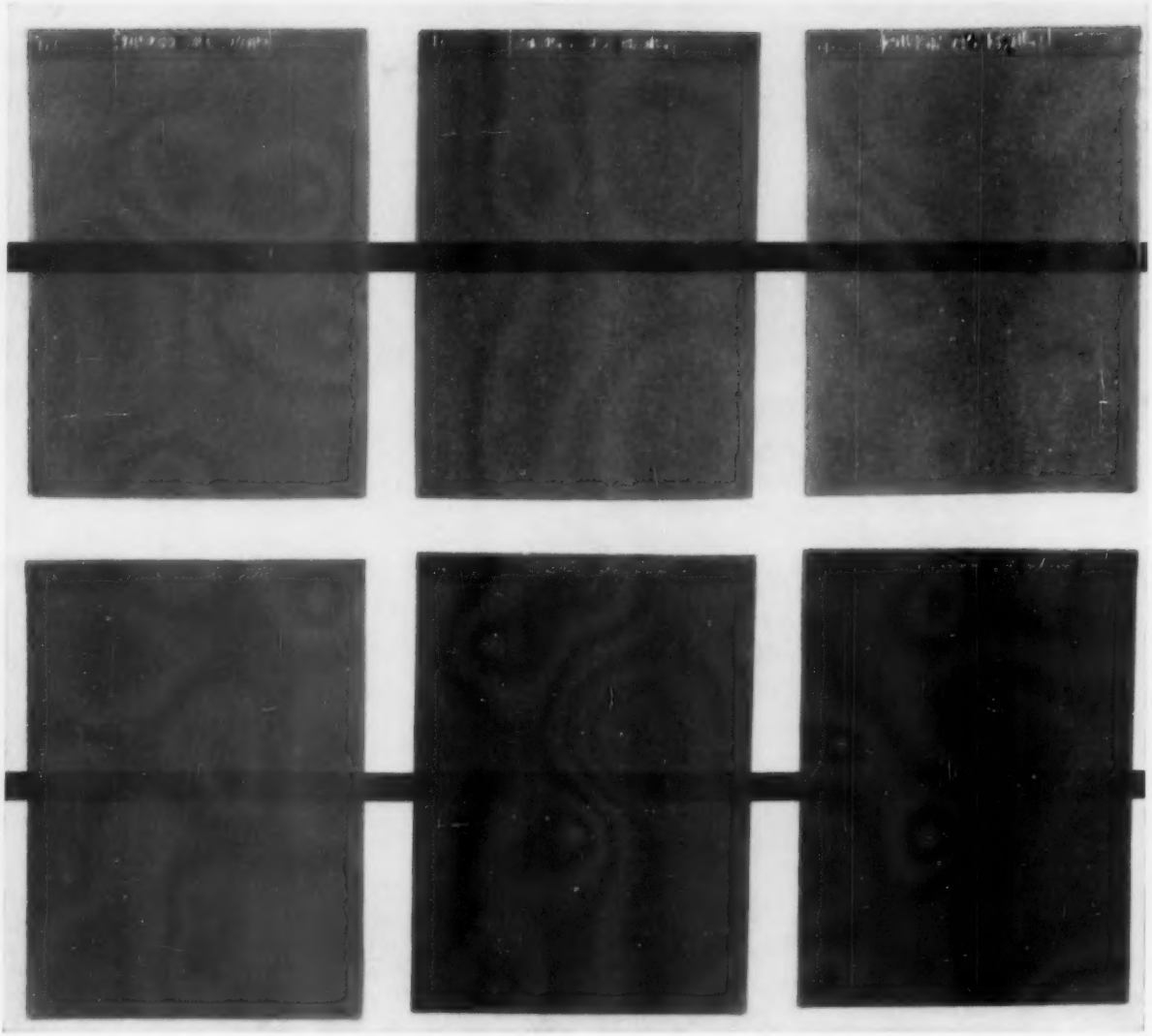


FIG. 5—A comparison of the transparency of several different types of nitrile rubber loaded with 20 volumes of Hi-Sil 233. All of the sheets in the top row and the middle and right end samples in the bottom row are based on the recipe shown in Table X and are vulcanized with a TMTDS-Santocure combination. The polymers used are: Top row, left to right: Hycar 1432, Hycar 1041, Hycar 1043. Bottom row, middle: Hycar 1001; right, Hycar 1002. The sample at the left of the bottom row is based on the recipe in Table XI and was made from Hycar 1001 vulcanized with Di-Cup. The peroxide produces a more transparent compound than the thiuram-thiazole combination when Hycar 1001 is used.

sulfur gave a definite improvement in transparency. In stocks cured with Sulfasan R and no free sulfur, there was no difference between the transparency of those containing zinc oxide and those containing stearate.

Acceleration: Investigation of accelerators that might be expected to be useful in producing transparent butyl stocks indicated that TMTDS and Methyl Zimate were the most satisfactory. These two ultra-accelerators gave almost identical physical properties as shown in Table XII. Two other dithiocarbamates, Accelerator 552 and Safex, proved slower curing in the initial test and were no more transparent so they were not tested further.

The compound containing TMTDS had better transparency than that accelerated with Methyl Zimate. Consequently, the thiuram was chosen as the accelerator for some additional work with vulcanizing agents. MBT was tested as a secondary accelerator in conjunction with TMTDS. It did not improve physical properties but did decrease transparency by a substantial amount.

Replacement of Sulfur: It was mentioned above that reduction of elemental sulfur improves transparency of butyl stocks. It would appear desirable, therefore, to eliminate elemental sulfur completely if satisfactory cure can be obtained by other means. From combinations of sulfur and organic sulfides such as Sulfasan R and VA-7, the next step was to test the sulfides alone. When this was done, fairly good physical properties were obtained in both cases.

The compound containing VA-7 as the sole vulcanizing agent when cured for 30′ at 320°F. had the best trans-

parency of any butyl stock prepared in the course of this work. When cured *60'* the stock became much darker and was much less transparent. It will be noted from Table XII that its physical properties were considerably below those of the two sulfur-Sulfasan R cured stocks. As mentioned before, VA-7 also imparts a distinct odor which is not a desirable characteristic.

The compound containing Sulfasan R as the sole vulcanizing agent had better physical properties than the VA-7 cured stock but it was not transparent. The best that can be said for it would be that it was translucent after a *60'* cure. Properties of the two butyl compounds which contain no free sulfur are shown in Table XII where they are compared against two stocks cured with combinations of sulfur and Sulfasan R.

Peroxide Cure of Butyl: Curing with quinone dioxime and dicumyl peroxide (Di-Cup) produced a stock with good physical properties, particularly modulus, but it was black and opaque. As the use of Di-Cup to cure butyl has not been reported previously, the results are given below for general interest. The recipe used was:

Butyl 268	100
Hi-Sil 233	39
GMF	2
Di-Cup	0.25

Mins. Cure at 320°F.	Modulus 500%	Tensile	Elong.	Duro. 0″	Hard. 30″	Tear
20	1010	1930	730	61	46	210
30	1120	2040	720	61	47	240
40	1130	2040	700	60	47	260
60	1200	2120	710	61	47	260

TABLE XI—COMPARISON OF PHYSICAL PROPERTIES AND OPACITY OF TRANSPARENT NITRILE RUBBERS CURED WITH DICUMYL PEROXIDE

Test Recipe

Hycar	100.00
Hi-Sil 233	39.00
Di-Cup	1.25
Trimene Base	1.00
Stearic Acid	0.50

Type of Hycar	Mins. Cure at 310°F.	Modulus 300%	Tensile	Elong.	Duro. Hardness 0″	Duro. Hardness 30″	Tear lbs./in.	Opacity %
1043	10	570	1120	630	70	52	250	
	20	740	2180	680	70	55	310	41.0
	30	950	2850	660	70	57	330	
	45	1050	3280	620	70	58	280	
	60	1120	3380	610	70	60	270	
1432	10	680	2180	830	77	55	360	
	20	840	3210	760	77	59	400	45.9
	30	1050	3640	690	77	60	410	
	45	1270	3930	630	78	60	380	
	60	1330	3990	620	80	63	390	
1002	10	1660	2670	420	72	63	230	
	20	2280	2480	320	75	67	200	47.7
	30	—	2330	290	77	70	180	
	45	—	2140	260	75	70	180	
	60	—	2430	290	75	70	170	
1041	10	500	1330	820	75	50	290	
	20	610	2100	780	75	52	300	Too Dark
	30	680	2650	770	75	53	330	
	45	730	3020	720	75	53	330	
	60	800	3180	700	75	55	330	
1001	10	1110	3160	590	73	58	310	
	20	1480	4050	560	73	61	250	Too Dark
	30	1750	4040	520	74	64	250	
	45	1650	3730	490	73	63	230	

TABLE XII—PHYSICAL PROPERTIES OF TRANSPARENT BUTYL COMPOUNDS CURED WITH AND WITHOUT SULFUR

Test Recipe

	XII-A	XII-B	XII-C	XII-D
Butyl 268	100.0	100.0	100.0	100.0
Hi-Sil 233	39.0	39.0	39.0	39.0
Zinc Oxide	1.0	1.0	—	1.0
TMTDS	2.0	—	2.0	2.0
Me. Zimate	—	2.0	—	—
Sulfur	1.0	1.0	—	—
Sulfasan R	1.5	1.5	—	3.0
VA-7	—	—	3.0	—
Diethylene glycol	2.5	2.5	2.5	2.5
Stearic Acid	1.0	1.0	—	1.0
Zinc Stearate	—	—	3.0	—

Compound	Mins. Cure at 320°F.	Modulus 500%	Tensile	Elong.	Duro. Hardness 0″	Duro. Hardness 30″	Tear lbs./in.	Per Cent Opacity
XII-A	10	590	2480	810	56	46	220	
	15	640	2470	790	57	47	210	
	20	690	2340	760	57	48	200	74.1
	30	720	2170	740	57	49	190	
	60	610	1920	750	57	47	190	
XII-B	10	580	2450	810	55	45	230	
	15	640	2580	800	56	46	220	
	20	710	2470	760	56	47	220	83.3
	30	760	2330	740	58	50	200	80.4
	60	770	2190	730	58	50	200	
XII-C	10	250	1010	1020	52	36	120	
	15	330	1340	930	52	38	150	
	20	380	1580	890	54	42	160	74.3
	30	450	1710	860	54	45	200	36.1
	60	390	1380	900	54	42	170	90.6
XII-D	10	390	1540	800	54	42	230	
	15	500	1960	790	54	44	250	Translucent
	20	630	2070	770	54	46	230	None trans-
	30	680	2150	760	55	48	220	parent.
	60	640	1890	740	56	48	210	

TABLE XIII—EFFECT OF SILICA AND SILICATE PIGMENTS IN NEOPRENE

Test Recipe

Neoprene WRT	100.00
Pigment	As Shown
E.L.C. MgO	0.75
Zinc Oxide	0.75
NA-22	0.50

Cure: 10′ x 307°F.

Pigment Loading	Modulus 300%	Tensile	Elong.	Duro. Hard.	Tear lbs./in.	Transparency
None	210	1320	650	41	90	Transp't Dark.
Hi-Sil 233, 19.5 PHR	810	2520	670	53	310	Nearly opaque
Hi-Sil 39 PHR	1270	2410	570	66	500	Opaque
Hi-Sil X303, 19.5 PHR	1180	1780	460	56	310	Nearly opaque
Ultrasil VN3, 19.5 PHR	870	1810	550	58	270	Nearly opaque
Silene EF, 21 PHR	940	1520	460	56	260	Opaque

Increasing the Di-Cup to 0.5 PHR resulted in a loss of about 20 per cent in tensile strength and tear resistance. Use of 1.75 PHR of Di-Cup with 2 PHR of GMF caused the stock to revert to such an extent that it could not be removed from the mold. In vulcanizing butyl with this sort of curing system it appears that the dicumyl peroxide must be held under 0.5 PHR.

Neoprene Rubber

A limited amount of work with silica and silicate pigments in neoprene did not result in production of any transparent compounds. Evidently the refractive indexes of these pigments are quite different from that of neoprene. No extensive amount of work was done because even a pure gum neoprene stock, although transparent to strong light, had much poorer transparency and was much darker than loaded natural rubber, styrene-butadiene rubber or nitrile rubber compounds. Obviously, the addition of 20 volume of any pigment would not improve transparency over that of pure gum.

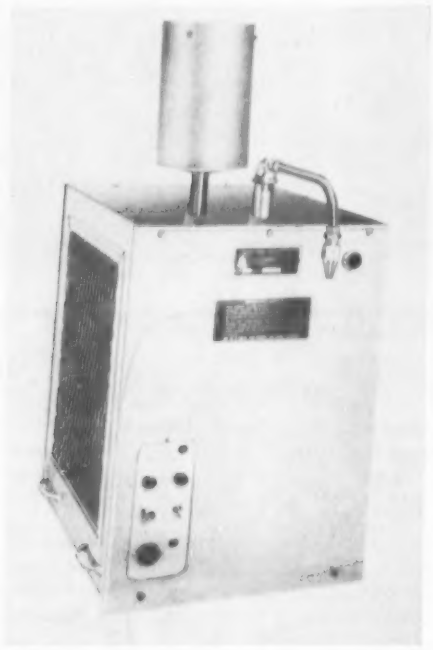
The work that was done with neoprene was with Type WRT, which the supplier states is best suited for production of transparent neoprene stocks (3). The recipe used in these tests and results obtained on tensile sheets cured 10 minutes at 307° F. are shown in Table XIII. Transparency was not changed by increasing the cure time to 30 minutes.

LITERATURE REFERENCES

(1) "Transparent Shoe Soling," Technical Report No. 4:2A, Polymer Corp., February, 1955.
(2) Wolf, Ralph F., "Compounding of Colored Butyl Rubber Goods," *Rubber Age (N. Y.)*, Vol. 75, pp. 389-395 (1954).
(3) "Transparent Rubber from Natural Rubber and Neoprene," Blue Letter 273, E. I. du Pont de Nemours & Co., Inc., December 31, 1954.

Triplematic Dispensing Machine

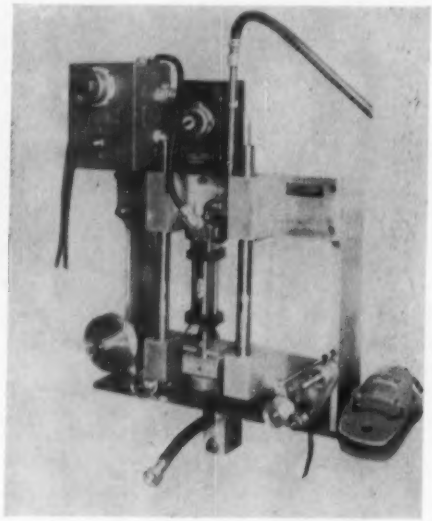
Engineers at H. V. Hardman Co., Inc., Belleville 9, N. J., have designed a new dispensing machine for two-part, self-curing flowable resin systems. Called the "Triplematic," it is said to meet the demand for a machine to utilize the advantages of the systems in production items. The new unit meters the correct proportion



of curing agent and resin, mixes them intimately, and discharges a pre-selected amount. Various models handle liquid resin such as epoxies and resorcinols with their curing agents. Model 503A ejects mixed resins from a minimum of 0.3 ml to a maximum of 3.0 ml per shot, whereas Model 520A has a range of 1 to 20 ml per shot at demand speed up to 72 shots per minute. The mixing chamber may be purged with resin alone to prevent freeze-up. Standard 115-volt, 60-cycle A.C. is required; no air or water connections are necessary.

Marking Hose and Wire Coder

A new transleaf-type coder adaptable for marking such products as rubber and plastic hose and insulated wire and cable has been developed by the Industrial Marking Equipment Co., 454 Baltic St., Brooklyn 17, N.Y. The machine imprints all combinations of numbers, letters and colors for product identification and



quality control. The impressions are said to be clear, sharp and permanent, regardless of the diameter of the item imprinted. For operator convenience there is a foot switch control. Since a permanent roll-leaf method of printing is used, there is no make-ready or inking necessary. According to the manufacturer, it is possible to obtain up to 20,000 impressions for every dollar of operating cost with the new coder.

A new high-powered 3.5 kw **electronic heat sealer**, the Model 350, is offered by the Sealomatic Electronics Corp., 429 Kent Ave., Brooklyn 11, N. Y. The unit is built with 4 kw components to assure full power, continuous high output and longer life. The firm's exclusive ArcGuard protection feature is also incorporated.

Shown above is the moderator and the panel of the symposium on "Physical Testing in the Rubber and Plastics Industries" held by the Akron Rubber Group.

Physical Testing in the Rubber and Plastics Industries

A Report on a Symposium Held by the Akron Rubber Group

THE Winter Meeting of the Akron Rubber Group, which was held on January 25, 1957, at the Sheraton-Mayflower Hotel in Akron, Ohio, featured a symposium on "Physical Testing in the Rubber and Plastics Industries." The six panel members who participated in the program each delivered a short paper on some aspect of the subject under discussion. The presentation of the papers was followed by a question-and-answer period. L. V. Cooper (Firestone) served as the panel moderator and established the premise for the meeting in his introductory remarks.

The following subjects were covered at the symposium by the panelists noted: *Equipment*, David C. Scott, Jr. (Scott Testers); *Plastics and Insulated Wire*, John T. Blake (Simplex Wire & Cable); *Fabrics*, John H. Dillon (Textile Research Institute); *Tire Compounds*, John W. Liska (Firestone); *Mechanical Goods*, Sherman R. Doner (Raybestos-Manhattan), and *Specialty Rubbers*, W. Newlin Keen (DuPont).

In his introductory remarks, Mr. Cooper observed that the object of all physical testing is to accurately predict from laboratory tests the service life of the finished product. Testing incoming materials and control of batches during processing insures a finished product that is consistent and at a definite quality level. Correctly evaluating new materials against the material currently in use makes possible increased quality or the same quality at a lower cost.

The first physical testing machines were human arms and teeth, Mr. Cooper noted. By trying to flex a strip of rubber, the first tester gained a fair idea as to modulus, tensile and tendency to take a permanent set. A good chew on the corner of the slab gave a check on hardness and resistance to tear and cutting. Even today, there are those who say that the "bite" test is the best cutting and tearing test we have, he stated.

During the past hundred years and particularly the past forty, many machines have been devised to put a numerical evaluation on certain properties of materials and combinations thereof. Some machines evaluated properties no longer needed today. For instance, the soft rubber to hard rubber adhesion so necessary in solid tires is a dead item today as the rubber to metal adhesion in present mechanical goods is now direct adhesion.

The speaker remarked that the high-speed service de-

manded of tires, the skin temperature developed on the surface of planes and missiles traveling faster than the speed of sound, the development of many rubber-like material industrial applications and other factors have caused a change in the concept of physical testing especially within the last ten years.

One of the major problems in physical testing concerns personnel, not only as to the number on the staff but what type of person should be employed. One company feels it shall be a first year training course for young engineers. At another, it has become an "old folk's home"—the place where near-pensioners or physically handicapped are taken care of until they quit.

Mr. Cooper recalled that Edison once said that progress comes as a result of 2% inspiration and 98% perspiration, and it is admitted that the physical testing division is the perspiration part of progress. However, a physical testing division which simply turns the crank either due to an overload of work or lack of ability on the part of personnel is not a true asset to any company. The desirable condition is a staff which can not only aid others but has the ability, time and facilities to design new equipment to do a better job of predicting probable service life.

Financial conditions are satisfactory in the rubber industry at present and companies are willing to stand the expense of large road test fleets. Should conditions change, pressure will be brought to bear to use laboratory tests to thoroughly screen proposed road test possibilities and the company with the most advanced and complete laboratory equipment will have a distinct advantage, he concluded.

The talks made by each of the panelists at the symposium, follow:

Equipment

By DAVID C. SCOTT, JR.
Scott Testers, Inc., Providence, R. I.

IT certainly is a pleasure to lead off this part of the symposium on "Physical Testing in the Rubber and Plastics Industries." It is appropriate for an instrument manufacturer to be in this position. He tries to anticipate the requirements for the evaluation of physical properties and develop equipment for fulfilling them. To further permit the compounder to progress further with his activities, we try to furnish him with the information necessary for controlling the processing of his materials as the industry needs experience them. The accent seems recently to have been concerning the stabilization of physical properties. This, we believe, has probably been brought about through two strong impacts that our economy has encountered.

The first of these is the excessively high heats generated in the rotating members of the propulsion equipment, or in the skin frictions generated within the units being driven at high speed. The second is the obvious limitations that present themselves when standard equipment is taken into new areas and the conditions reflect a deficiency in one or more physical properties.

Military Requirements Cited

The military have indicated to all of us that it is not unusual to experience a temperature of minus 50°F. in the Arctic and Antarctic regions. To take care of these extreme temperatures, it has been necessary for the compounder to adjust his compounds to a point where the materials will be acceptable at these temperatures. Some equipment, namely, gaskets, shock absorbers, etc. which has these compounds incorporated into it, is of an airborne nature and has rotating equipment which generates terrific heats when in operation. Inasmuch as it flies at extremely high speeds, the surface friction on the members subjected to wind again generate extreme temperatures.

We instrument makers in trying to keep pace with these requirements offered, as early as 1946, a tensile tester with equipment suitable for producing testing temperatures of from minus 70° to plus 350°F. After the Arctic operations had been conducted by the Army in the late '40's, we offered an instrument for evaluating the brittleness or freezing point of elastomers. The A. S. T. M. has incorporated the use of this instrument as standard procedure in one of its specifications. This instrument again is capable of producing temperatures within the conditioning bath of down to minus 120°F.

About two years ago, the B. F. Goodrich Company Research Laboratory at Brecksville, Ohio, adapted a block of aluminum into a conditioning bath through the use of electrical heat. The advantages of this conditioning bath enabled high temperatures to be obtained through a safe, clean and relatively free from maintenance means at a temperature tolerance that is almost unbelievable. The big feature that was incorporated into this was the complete segregation of the individual samples during their subjection to high temperature. The complete segregation of the samples permits each individual sample to be evaluated on its own merits. They are, therefore, prevented from being further deteriorated or bolstered, as the case might be, by outside influence generated by dissimilar samples being tested within the same container.

These units are capable of producing temperatures for aging up to 600°F. Like every user of instruments, the compounder had requests for instruments that would be capable of taking care of requests for higher temperatures than the standard units were capable of producing. We, therefore, had to do some searching and produce a unit which would meet these requests and comply with temperatures as high as 1000°F. This necessitated the substitution of stainless steel for aluminum, for the aluminum that was being used for the purpose melted at a temperature of 1200°F.

Plastic Quality Evaluation

For the evaluation of the plastic quality of unvulcanized elastomers in a raw, as well as a compounded state, we had been furnishing our Model NBS Mooney Viscometer, and up until 1948, 212° seemed a satisfactory temperature for this evaluation. More recently, however, new materials were discovered which required greater heat to fabricate. The Mooney, in order to give the proper assistance to the compounder, had to be adapted

to fit the purpose. Temperatures of up to 350° became a "norm" in many instances, and the original instrument, as it was designed, left much to be desired. We, as an instrument manufacturer, foreseeing this requirement, had to develop a completely new design which would be capable not only of producing temperatures up to 400°F, but also would operate over periods of time at that temperature, without undue deterioration of bearings and other rotating parts.

The instrument industry is one which produces a relatively small quantity of units. We try at all times to anticipate the requirements of the compounder. Frequently, however, we meet ourselves coming around a corner when we start searching for materials that would be suitable for inclusion into our instruments. One case in point:—we were recently asked to produce a pressure chamber which would be suitable for the maintenance of an atmosphere deteriorating to rubber, but would also have a flexible seal which would not need replacement when operated at high temperatures. The usual sources of supply that we looked to for this type of material were exactly the ones who were asking us to produce the instrument for evaluating it. As stated previously, the quantity of components that we required was so small that they were not particularly attractive for anybody to produce them, without excessively high cost.

In the above, I have purposely stuck to the one subject of temperature. My reason for doing this is because you are very familiar with the conventional tensile tester, its advantages, and its problems, and I expect in the question period to follow, to cover the details concerning such apparatus.

Plastics and Insulated Wire

By JOHN T. BLAKE
Simplex Wire & Cable Co., Cambridge, Mass.

IN the few minutes allotted me, I am to discuss the physical testing of plastics. Obviously, this is a big subject and I shall confine my remarks to a few special problems in this field. The most common tests are those of tensile strength and elongation. There are problems in connection with plastics that are not so important in the testing of rubber. One of them is the difficulty of getting a good grip on the sample in the jaws of the tension machine. This is particularly true of the harder plastics, or samples that have been subjected to accelerated aging, or samples which have been immersed in oil possibly at elevated temperatures and for long periods of time. Samples of plastic insulation which have been prepared by removing the conductor from a small insulated wire and which, therefore, must be tested as a tube present a similar problem.

One method we have developed for overcoming some of these troubles is to cover the parallel type of tensile jaws with a soft, wax-free vulcanized natural rubber. Fragile samples are gripped gently but firmly. These jaws are better also for samples which tend to neck down. Another method we have used is to wrap the test sample with an abrasive-covered paper or cloth at the place where the jaws grip the samples. This tends to distribute the jaw pressure and reduces slipping. It does not overcome the trouble with samples which neck down when stretched.

These devices are makeshifts which have allowed us to get more satisfactory tests than can be obtained by conventional methods. Possibly the makers of test equipment could be of real help to industrial laboratories by supplying special jaws for purposes where we now have trouble.

Testing Rigid Plastics

The testing of some of the newer rigid and semi-rigid plastics poses problems in setting suitable standards and interpreting the test results. As an illustration, the newer types of crystalline polyethylenes give results that differ greatly depending on the rate of stretching. One material when tested at a rate of 20 inches per minute gives an ultimate tensile strength of nearly 4500 p.s.i. This is not a great difference but the elongation results are of an entirely different order of magnitude. At 20 inches per minute this same material gives an ultimate elongation of *20 to 30%* but at 0.2 inches per minute the elongation is *400%*.

One can ask readily which of these values is the one we want as a control and ask also the relationship of this twenty fold variation in elongation to service conditions. How can we discriminate between materials for a particular service? As a side issue, testing at 0.2 inches per minute is intolerably slow and naturally decreases the productivity of a laboratory.

Notch Sensitivity

There is another related problem that we call notch or nick sensitivity. Some of the new rigid and semi-rigid plastics may fail if there is a nick, cut or notch in its surface and the sample is bent. This type of failure can occur when an insulated wire sample is bent to a degree that might be met during the manufacture and installation of cables. It provides a problem both in obtaining consistent tests and relating the test method to service conditions. Obviously, the type of nick or notch, its depth and the rate of application of the stress, as well as the degree of strain, produce widely varying results.

Some of the newer crystalline polyethylenes are subject to so-called heat shock. Samples of material extruded on wire and then wrapped around its own diameter may crack completely at temperatures of about 110° to 120°C. This sort of test was used in the early days of PVC insulations and was a measure of inherent strains. In the case of PVC the usefulness of this test has disappeared but now it is an important test for some of the newer materials.

The standard A.S.T.M. heat distortion test, when used for ordinary grades of polyethylene, is misleading to people not familiar with this particular test procedure. This is a test in which a beam sample is supported 4 inches apart and subjected to a load applied in the middle of the beam. The load is adjusted to produce a definite

fiber stress and the temperature is raised until a distortion of 10 mils occurs. For standard high-pressure polyethylenes a distortion temperature of 122°F is produced and this low value has at times in the past scared potential users. Probably a new method relating more closely to service conditions should be evolved if the name of this test is to be retained.

For years, abrasion tests on rubber samples have been made in the laboratory and, although it is recognized that they must be supplemented by road testing, in the case of tires, they have been useful tools for development. Similar abrasion tests on plastics give results that are much more difficult to relate to service conditions. Plastics are being used more and more in situations where abrasion resistance is an important property. Probably work should be done on laboratory abrasion tests that will be of greater utility

The irradiation of polyethylene is producing materials which have attractive and interesting properties. It may be that special tests will be required to appraise these materials in terms of service.

In this short space of time I have tried only to point out a few areas where there are problems in the testing of plastics. There are many other problems for which solutions must be found as the utility of this field of materials increases.

Fabrics

By JOHN H. DILLON
Textile Research Institute, Princeton, N. J.

IT is very pleasant for an old Akronite to find himself participating in this symposium on physical testing, sponsored by the Akron Rubber Group. It seems that my subject is the physical testing of fabrics, presumably as they are applied in the rubber and plastics industries. When I first looked seriously at my assignment, it all seemed quite straightforward; this would surely deal with industrial fabrics—tire cord, belting ducks, laminating cloth, etc. But a closer examination forced me to accept a wider scope. After all, a substantial part of the production of the plastics industry goes into formaldehyde resins which are used to impart wrinkle recovery to rayon and cotton apparel fabrics. Similarly, rubber latices have been used with some success to stabilize woolens. These and other examples suggested to me that my remarks must apply to fabric testing in general, rather than to that great but limited field of industrial fabrics.

Application of Statistical Theory

Probably one of the greatest advances in textile testing techniques during the past ten years has been made by the application of statistical theory to the planning and interpretation of experiments. One will find even in the modest control laboratory of a small mill a good understanding of statistics and, therefore, an appreciation of the significance of the few tests that are made. This is heartening for it indicates real progress. But what of the ultimate meaning of the test results in terms of product performance; little attention is paid to that! I'll venture that 75 per cent of all fabric testing in this country today is done with no real concern for quantitative correlation or even pseudo-quantitative ranking of test results with product performance.

Now this is understandable and, in a sense, justified. First of all, attaching meaningful numbers to fabric performance is very difficult, especially in the apparel field where consumer subjectiveness is hard to evaluate. Secondly, it is rather gratifying to be able to control the quality of a given type of fabric within narrow statistical limits by applying some arbitrary strength test and thus avoiding rejects, purely on the basis of blind qualitative experience. Indeed, this is an accomplishment from the standpoint of the "as is" world. But the tester of fabrics, or anything else, should also be thinking about the "as we'd like it" world and that means not just controlled but improved products. Improved products are difficult to achieve through smugly precise qualitative control testing—they come naturally by quantitative extension of physical test data obtained on the constantly changing products of the chemist and engineer.

Load-Strain Tests

But now suppose we get down to cases—just a few significant examples. Load-strain tests come first to mind because of the frequency of their use. They are also probably important because they can provide numbers to describe effects ranging from degradation by heat to deterioration caused by the attack of carpet beetles and cockroaches. Like all mechanical tests in textile materials, they must be performed under controlled humidity and it is well to have a reasonably constant temperature also. The newer hydrophobic fibers are, of course, not as sensitive to humidity as are cotton, wool, rayon and acetate. Nevertheless, one must not be misled by a regain of 4 per cent or less; sometimes a small change in moisture in a hydrophobic fiber will have a profound effect on physical properties.

I don't propose to engage in a controversy concerning constant rate of traverse vs. constant rate of loading. Most of the existing pendulum and incline plane testers are capable of accurate, useful results, if properly operated with an understanding of their basic mechanical limitations. For the greater precision and versatility required in a research laboratory, however, a variable-speed, inertia-free strain-gage type tester is desirable. I suggest that a simplified strain-gage instrument will become commonplace in routine control testing laboratories in not too many years, simply because it can be used for so many purposes. For example, an instrument of this type can be employed as a very sensitive thickness gage.

Load Extension Testing

The conventional load-extension testing of fabrics is a pretty crude business, of course, regardless of the type of testing machine employed. Measuring breaking load, either in the warp or fill directions, or both, seldom has any sensible bearing on the service conditions of the fabric. Measuring the load-extension function in warp

and fill directions simultaneously, with each initially orthogonal set of yarns reacting on the other, is not very difficult and the resulting realistic load-extension curves only faintly resemble those obtained by conventional uni-axial tests. Yet the conventional "grab" or "cut strip" uni-axial test is "so easy"—why not keep using it, whether its results have meaning in product performance or not?

It is quite refreshing to deviate from the testing of apparel fabrics to regard the strenuous efforts of people in the rubber and plastics industries. Here it seems, at last, that there is an appreciation of the importance of time as a parameter in elastic performance of high polymers. I'm not sure that there is yet universal agreement on a tire cord fatigue test but it seems, at a glance, that fatigue contraptions are a little more scientifically sensible than they used to be.

I must admit that long ago I participated in the design of a marvelous cord fatigue tester. It was wonderful for cotton cords but, when high tenacity rayon came along and then nylon, it was even more successful—it fell apart in its violent efforts to rupture these brave fibers in continuous filament form. Perhaps if we had more examples of outmoded devices and techniques actually falling apart, we would be further along in the quest for more revealing physical tests for fabrics.

Tire Compounds

By JOHN W. LISKA
Firestone Tire & Rubber Co., Akron, Ohio

PHYSICAL testing of tire compounds can be conveniently broken down into four broad classifications: first, control testing; second, testing to determine optimum vulcanization state; third, processing tests, and finally, testing for compound development. It is probably safe to say that reasonably satisfactory tests for control and optimum cure state are well known and used daily, hence, in the interest of brevity no discussion of these aspects of the subject will be undertaken. In the brief time available on this panel discussion, it is obviously impossible to discuss the third and fourth classifications in any great detail. At best, only a very short summary can be given.

Processing Tests

With respect to processing tests, it would seem that plasticity and tack determinations are the most important. Laboratory plasticity tests have been improved, over the past several years, to the point where it can be said that they are nearly adequate for most tire compound applications. Despite continuing efforts to devise a "tack" tester, however, the laboratory measurement of building tack continues to be more or less unsatisfactory. More fundamental studies of this important quality appear in order.

In the fourth category are included all of the tests such as cutting, cut growth, cracking, fatigue, ozone, aging, abrasion and tearing resistance. Since a complete discussion of all of these is obviously impossible, I propose to concentrate my remarks on those tests which seem to be farthest from a satisfactory solution at the present time.

Ideally, it would be highly desirable to quote some formulas which would enable the technical man to specify the exact number and types of compound tests which are required for a particular application, precisely how these tests should be run and finally how the test results should be interpreted and evaluated in terms of expected tire service or tire lifetime. Unfortunately, such formulas simply do not exist today. Although some new specific tests have been devised in recent years and some of the older ones have been improved, translation of laboratory compound test data into anticipated tire performance results is still much more of an art than a science.

For a number of years, the tests employed for compound development were essentially the same as those used for control or processing tests and it must be admitted that some very real gains in tire performance were made as a result of the use of the old standbys, "tensile, aging and simple flex test procedures." However, continually increasing service performance requirements have literally forced the development and use of new test procedures for compound development. Among these, it is believed that a test for the evaluation of the dynamic properties of tire compounds is one of the most important. Many of the recent gains in tire performance must be credited to the use of some type of dynamic test. The importance of evaluating modulus and hysteresis or heat build-up under dynamic conditions cannot be overemphasized. We have learned, too, that we must distinguish between heat build-up measured under constant stress conditions and heat build-up measured under constant strain conditions.

Unfortunately, a tire does not operate strictly under either one or the other of these laboratory conditions and so far, no one has hazarded more than a good "guesstimate" as to the relative weights which must be applied to heat build-up under constant stress and constant strain conditions, for the tire as a whole. Furthermore, it is quite generally accepted by now that different weightings of these parameters must be assigned to the different compounds used in the body, tread and sidewall of a tire.

Weighting Test Results

The appropriate weightings of constant stress and constant strain test results which must be used for the different tire compounds are even less well understood than those for the tire as a whole. Consequently, one can only suggest that this phase of testing must be studied more intensively in the future. Increasingly severe service conditions are also requiring that more attention be paid to testing at elevated temperatures, in order to predict more accurately tire performance at elevated temperatures.

No discussion of physical testing of tire compounds would be complete without some reference to abrasion testing. A number of laboratory abrasion machines have been devised over the past few decades, but it is believed none has been found completely satisfactory for predicting abrasion or wear resistance of a tire under service conditions with high precision. The reason for this lack of agreement is not too difficult to understand, nevertheless, this does not make it easier to devise laboratory tests which will agree better with service tests.

It is becoming more and more unlikely that the problem can or will be solved by the empirical approach which has characterized most of the abrasion machines of the past. The best approach to a good laboratory abrasion test now appears to be through a thorough analysis of the complex abrasion processes into a number of decisive properties (which combined, produce abrasion) followed by accurate measurement or evaluation of these separate properties and finally incorporation of these separate measures into an appropriately weighted, single index of abrasion.

Tear resistance is another important characteristic of a tire compound which has proved difficult to evaluate in the laboratory. Tearing, like abrasion, is a complex process and though the measurement of tear resistance has yielded somewhat more completely to the empirical approach than abrasion resistance, it is believed that a more complete understanding of this subject too will be realized only as the result of the type of approach discussed earlier in this discussion under abrasion resistance.

In summarizing, it can be concluded that for the most part, reasonably satisfactory test procedures are now available for use in selecting tire compounds for specific end uses, with a few notable exceptions. It is believed that more attention will have to be focussed on dynamic testing and compound evaluation at elevated temperatures. In addition, it would appear that good laboratory tests for abrasion and tear resistance will come only as a result of fundamental studies of the nature of these processes leading up to mathematically weighted quality indices for these two characteristics.

Mechanical Goods

By SHERMAN R. DONER

Raybestos-Manhattan, Inc., Passaic, N. J.

THE mechanical rubber goods division of the rubber industry is that segment devoted to the manufacture of all products which do not fall into the classification of tires, druggist sundries, wire and footfear. In other words, mechanical rubber goods comprises hose, belting, molded parts, extruded goods, lathe cut goods, etc. Our segment consumed about 20% of the total natural and synthetic rubbers used in the United States in 1955. As you can see we are a relatively small segment of the total rubber business in terms of rubber consumed, but we have perhaps more than our full share of problems. Hundreds of thousands of items fall into the category of mechanical rubber goods and each presents its own design, production and testing problems. Since this symposium is on the testing of rubber, I will confine my remarks to a few specific items.

Hose, for instance is produced in sizes ranging from 1/8-inch I.D. to over three feet in inside diameter. Automotive hydraulic brake hose is a 1/8-inch hose made with a synthetic rubber tube and two braids of cotton yarn with a neoprene cover for good weather resistance, it is either lead press or wrap cured. This hose is made to comply with the requirements of SAE specification 40R1, which requires that the hose have a minimum bursting strength of 5000 PSI. Its expansion under pressure shall not exceed 0.56 cc. at 1000 PSI and 0.67 cc. at 1500 PSI for a ten inch length. It must flex on the "whip test" machine for a minimum of 35 hours. This whip test consists of flexing a 15½-inch length of hose by holding one end stationary while the other end is rotated in an 8-inch diameter circle at 800 RPM.

During this test the hose is under 225 to 250 pounds hydraulic pressure. The test method contains this statement, "The flexing motion imparted by the test apparatus, while different from that to which the assembly is subjected in service, provides a highly accelerated method of measuring the resistance of a hose to dynamic fatigue," and this statement is so true.

The hose must be so constructed and coupled that a pull of not less than 325 lbs. is required to pull off the coupling. It must also meet a —40° freeze test. The control testing of this product requires constant testing, but the proof of its value lies in the fact that one seldom hears of a brake hose failure on an automobile. A.S.T.M. method D-571 covers in detail the brake hose testing procedure.

Hydraulic brake cups, used as seals in the master and wheel cylinders of automobiles are truly precision molded rubber parts; the dimensional tolerances must be maintained within close limits and the cups must remain dimensionally stable after a simulated service stroking test of 100,000 cycles at 1000 pounds pressure at 250°F. Brake cups were formerly made of natural rubber, now all heavy duty cups and many moderate duty cups are made from GR-S. Minimum quality requirements for the brake cups established by the SAE-60R-2 specification.

SAE Specifications Utilized

The purchasers of hydraulic brake cups without exception have specifications based on the SAE specification but with closer limits in some respects. The reason for this is to insure them that they are purchasing a product which will consistently meet the SAE requirements. The SAE specifications for brake hose, brake cups and brake fluids have been adopted by several states as minimum requirements for safety reasons, some of these states require approval of a product before it can be sold within its boundaries, and the trend is definitely toward more of this type of safety legislation.

In addition to the above two there are countless other automotive rubber items made from rubber such as motor mounts, bumpers, weatherstripping, dynamic and static seals, coolant, heater and power steering hose, to mention a few. Many of these items are specified

by the use of SAE-ASTM specification D-735, which as we know is a convenient and flexible classification of rubber materials, special tests such as compression-set, immersion in various fluids, load deflection, flex resistance, weather aging, etc. can be included by the use of suffix letters. D-735 has been a great help to both the automotive user and his rubber supplier in that it gives us a common language we both understand.

A discussion on mechanical rubber goods would not be complete without mentioning belting. Belting is one of the items responsible for the use of more textiles than any other branch of our business. Belting can be roughly divided into two classes, flat belting and V-belts. Flat belting covers conveyor, elevator, power transmission, etc. Flat power transmission belting is rapidly becoming an obsolete power product. The use of conveyor belting is expanding, it is taking the place of the familiar mine trains in many coal mines, and belts are being used to transport every conceivable type of item or material including homo sapiens. Formerly, the textile re-enforcement of belting was cotton, but today rayon, nylon, dacron and every other type of available strength member is being used or at least tested.

Until less than ten years ago conveyor belts were designed and rated strictly from theoretical figures. We now have several large belt dynamometers in our industry and on the basis of data obtained under simulated running conditions we are able to better evaluate the factors controlling the performance of conveyor belts and in recent years new speed and load factors have been published which indicate that in past years conveyor belt ratings were definitely on the conservative side.

In conclusion, I must say that the mechanical rubber goods industry is indebted to Committee D-11 of the American Society of Testing Materials for providing us with test methods that are applicable to most of our needs, also D-11 has constantly cooperated in providing any new test methods needed.

Speciality Rubbers

By W. NEWLIN KEEN

E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.

THE short-comings of natural rubber, such as poor resistance to some oils and solvents, led to the development of specialty elastomers. Once the chemist demonstrated that elastomeric materials could be made having specific properties, the design engineer has continued to put increasing demands on rubber-like products. So today we have Thiokols, neoprenes, Buna N's, butyls, silicones, Hypalon, urethanes, Poly FBA, Kel-F, and still others that are presently in the field evaluation stage.

From this group of materials, the rubber technologist can design vulcanizates that excel vulcanizates of natural rubber in resistance to oils, solvents, chemicals, natural aging, ozone, abrasion, low temperatures, or high temperatures. With the advent of these elastomers and with the design and application engineer stating the environment in which these materials should operate, test methods had to be modified, refined, and in some cases, designed.

Test Methods Considered

Let us consider the tests more or less in chronological order. In characterizing vulcanizates of these specialty elastomers as to their tensile strength, ultimate elongation, tear resistance, resiliency, heat build-up, compression set, flex resistance, and electrical properties, conventional test methods sufficed. The development of the oil and solvent resistant elastomers brought about modifications in ASTM D-471 Immersion Test for Elastomeric Vulcanizates. In testing compounds for such applications as gaskets, tank linings, and hose tubes where the oil or solvent comes in contact with only one side of the product, a test designed to bring only one side of the test specimen into contact with the test fluid helps in selecting the best composition.

Prior to 1940, there was very little low temperature testing primarily because vulcanizates of natural rubber met the requirements of the day. Today as you all know, it is common-place to be testing at —65° F. and lower in developing composition to meet many specifications.

With the specialty elastomers in general behaving differently from natural rubber at low temperatures and with the exacting requirements stipulated by the engineer, ASTM Committee D-11 has the following group of low temperature tests:

D-736	Thiokol-Bent Loop Test
D-746	Brittleness by Impact
D-797	Firestone Young's Modulus
D-1043	Clash-Berg Torsional Stiffness
D-1053	Gehman Torsional Stiffness
D-1229	Low Temperature Compression Set
D-1329	Low Temperature Retraction

In some aeronautical and automotive applications, specialty elastomeric parts selected on the basis of just hardness and simple load-deflection characteristics were put into field tests and did not perform satisfactorily. The development of dynamic testing equipment revealed the fact that the relationship between the static and the dynamic modulus of most specialty elastomers was quite different from that of natural rubber. Thus we have a free vibration tester, the Yerzley Oscillograph (ASTM D-945) and forced vibration testers such as the Goodyear Unit, Firestone Unit, the Buick Machine, the Lord Dynamic Modulus Tester, and others. All of these units are so designed that they may be operated over a broad temperature range.

Another characteristic of these new elastomers noted in field testing was strain relaxation or creep. Different types of creep tests were designed, most of them straining the vulcanizate in shear. Chief among the several factors having an important effect on creep are, amount and type of strain and temperature. It has been established that the higher the initial strain, the higher the creep and the higher the temperature, the higher the creep. Creep is greater under tension strain than under equal shear strain and it is greater under shear strain than under equal compression strain. Creep is also greater under dynamic loading than under static loading.

In part, as a result of the specialty elastomers differing from natural rubber under dynamic conditions, interest grew in learning more about the low-strain portion of the stress-strain curve. What was its true shape? Such instruments as the Instron, the Acer-O-Meter, and others with a strain gauge weighing systems helped answer this question. These instruments also afforded the rubber technologist for the first time a means of testing at constant rate of strain.

Along with the development of the new elastomers and diversified applications of elastomeric materials, particularly in the automotive and aeronautical fields, much work was done and is being done towards improving ozone testing chambers. A.S.T.M. D-470 describes the procedure for testing the ozone resistance of wire and cable compounds. In addition, A.S.T.M. D-1149 describes a test chamber and gives a procedure for determining the ozone concentration. There are some investigators of ozone who believe that you do not know how much ozone you generate unless pure oxygen is supplied to the ozonator.

In testing specialty elastomers designed specifically for high temperature applications, problems were encountered when conducting oven-aging tests. The solution to the contamination problem was found in the test-tube method of aging, and the difficulties with temperature control as 300°F. and up were eliminated by the electrically heated aluminum blocks. In addition to learning how well the vulcanizates withstand the effects of high temperature, it is becoming more and more important to know their physicals at these temperatures.

Supplementing these physical tests are simulated service tests. These tests are intended to duplicate the effects of the actual service conditions encountered by the product being evaluated. The devices used subject the products to controlled conditions until recognizable failure occurs. These conditions, however, are set to produce failure sooner than the time required in actual use.

[**EDITOR'S NOTE: A transcript of the questions and answers which followed the presentation of the papers will appear in the April, 1957, issue of RUBBER AGE.**]

Coming Next Month...

"How Voit Rubber Increased Productive Capacity Through Installation of a High Pressure Banbury-Extruder Combination"—by G. R. Gonyer, Farrel-Birmingham Co., Inc., Ansonia, Conn.

An article relating the manner in which Voit Rubber increased in mixing capacity through the installation of a high pressure Banbury-extruder combination designed for complete automation.

"A Comparison of Instruments Used to Determine the Suitability of Elastomers for Low Temperature Service. I—Hardness" by M. Hanok, C. K. Chatten and J. Z. Lichtman, Material Laboratory, New York Naval Shipyard, Brooklyn, N. Y., and T. A. Werkenthin, Bureau of Ships, U. S. Navy Department, Washington, D. C.

The first of several articles based on experimental work conducted at the Material Laboratory covering hardness, stress decay, brittleness, resilience, stiffness and compression set properties of elastomers at low temperatures.

"Procedure in Obtaining Patents"—by Kenneth W. Brown, Arthur S. Collins and Curt B. Beck, Godfrey L. Cabot, Inc., Boston, Mass.

Is the inventor's "brainchild" patentable? When should he submit his application and how is it to be prepared? Of what value is a patent? These and similar questions are dealt with in a series of articles beginning in the April issue.

Abstracts of Papers for the Joint Meeting of the Division of Rubber Chemistry, A.C.S., and the Rubber Chemistry Division, C.I.C., May 15-17, Montreal, Que., Canada.

Complete abstracts of all the papers to be presented at the joint meeting.

Plus several short practical articles.

THE CHEMISTRY OF REINFORCEMENT

III—Model Systems Containing Carbon Black and Squalene

By MERTON L. STUDEBAKER and LESTER G. NABORS
Rubber Chemicals Division, Phillips Chemical Company, Akron, Ohio

THE complex nature of unloaded rubber vulcanizates makes their direct study by chemical methods difficult. Our knowledge of the nature of the reactions which take place during vulcanization and the structure of the products is fragmentary. Reinforced rubber vulcanizates are even more complex and hence more difficult to study. A considerable amount of useful information can be obtained by studying the reactions of lower molecular weight hydrocarbons in the presence of sulfur, accelerators and other compounding ingredients. Farmer and his associates, *(1)* Armstrong, Little and Doak, *(2)* Olsen, Hull and France *(3)*, to name a few, have had noteworthy success in using such methods. Even though these model systems are complex, it is possible to separate the products of reaction and study them by the techniques of the organic and physical chemists. From the information obtained in this manner, we can reason by analogy on the course of the reactions which take place in rubber during vulcanization. As Farmer *(4)* has emphasized, one should exercise considerable caution in this, because it is not at all certain that the conclusions which are drawn from the reactions of a comparatively simple molecule like dihydromyrcene, for example, will apply unequivocally to a substance like rubber. Nevertheless, many of our current ideas on vulcanization are based on such studies.

Accordingly, similar simple systems have been utilized to obtain information to guide our studies of the chemical phenomena accompanying reinforcement. Squalene, which is made up of six condensed isoprene units, was selected as a substitute for natural rubber. To date, we have made only fragmentary attempts to study the liquid products of reaction. The carbon was merely heated with squalene, sulfur and/or other vulcanizing agents—singly or in combination. All mixtures were heated for one hour at 150°C. (except when obtaining the data plotted in Figure 11). The solid product was filtered from the liquid medium and extracted with toluene for thirty days, dried and submitted to precise ultimate analysis.

Analyses of Carbon Blacks

The carbon blacks used in this study were selected to give a wide variation in hydrogen content, oxygen content and surface area in a series which contains a limited number of samples. These samples had aged in the laboratory for various periods of time. Their analyses soon after production are listed in Table Ia. The analyses listed in Table Ib were made at the time the investigation was started, early in 1955. Aging the samples increased their hydrogen and oxygen contents.

Since all of the treated samples reported in this paper had to be extracted to remove sulfur, squalene or other compounding ingredients, and since toluene was used in all extractions, a blank run was made on each sample by extracting it for one month with toluene and subjecting the dried samples to ultimate analysis. The temperature of the carbon black in contact with the extracting liquid was observed to be 74°C., but no attempt was made to control this temperature and it probably fluctuated.

Extraction With Toluene

The analyses of the extracted samples, Table Ic, show that extraction with toluene for 30 days caused virtually negligible changes in sulfur contents of the samples, but the hydrogen contents were significantly increased. This can only mean that the affinity of the carbons for toluene is so strong that it was not completely removed by preliminary drying followed by more vigorous drying for one hour in a stream of dry nitrogen at 150°C. This suggests chemisorption. It is considered likely that carbon black chemisorbs toluene with dissociation into a free hydrogen atom and a free radical, $\phi CH\cdot_2$. This radical then combines chemically with the carbon black because of the ability of the latter material to act as a free radical acceptor. *(5, 6)* Although the changes in hydrogen content are not large, there is a rough proportionality between them and surface area as is indicated in Figure 1.

The increases in hydrogen content indicated in Table Ic are quite real, and were confirmed by preparing a second set of extracted samples and vacuum drying to con-

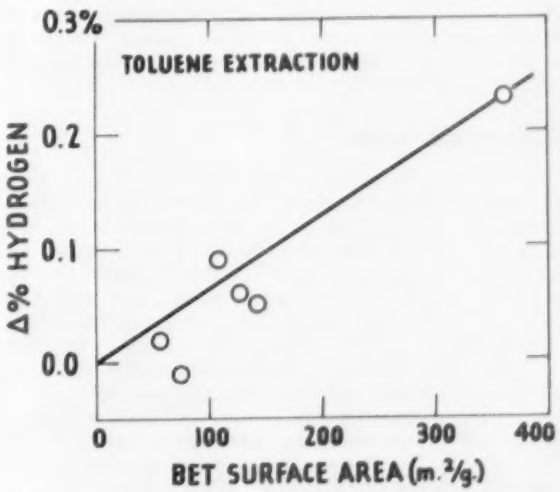


FIG. 1—The increase in hydrogen content during toluene extraction and drying for one hour in nitrogen at 150°C.

Note: This paper was presented before the German Rubber Association (Deutsche Kautschuk Gesellschaft) in Hamburg, Germany, in June, 1956.

TABLE Ia—ANALYSIS OF CARBON BLACK SAMPLES SOON AFTER PRODUCTION*

Sample	Type	BET Surface Area	%H	%C	% Ash	%S	%O By Difference
Spheron 9	EPC	108.6 m.²/g.	0.65	96.33	0.00	0.03	2.99
Spheron 6	MPC	128.5	0.51	96.68	0.03	0.00	2.78
Spheron N	CC	360.7	0.35	96.68	0.00	0.02	2.95
Philblack E	SAF	142.9	0.31	97.43	0.26	0.35	1.63
Philblack O	HAF	75.1	0.30	98.29	0.23	0.43	0.75
Shawinigan (Acetylene Black)	ACET	58.0	0.07	99.70	0.00	0.06	0.17

TABLE Ib—ANALYSES OF CARBON BLACK SAMPLES AT START OF THIS STUDY

Sample	Approximate Age of Sample	%H	%C	% Ash	%S	%O By Difference
Spheron 9	3 years	0.71	95.76	0.00	0.03	3.50
Spheron 6	3 years	0.55	96.25	0.00	0.00	3.20
Spheron N	1 year	0.37	96.44	0.01	0.02	3.17
Philblack E	2 years	0.34	96.83	0.27	0.40	2.16
Philblack O	3 years	0.31	98.29	0.23	0.45	0.72
Shawinigan	3 years	0.09	99.73	0.01	0.06	0.11

TABLE Ic—ANALYSES OF CARBON BLACK SAMPLES AFTER TOLUENE EXTRACTION

Sample	%H	%C	% Ash	%S	%O (By Diff.)	Hydrogen Increase *** (Δ %H)	2nd Series Δ %H	Average Δ %H
Spheron 9	0.80	95.94	0.02	0.05**	3.19	0.09	.03	.06
Spheron 6	0.61	96.07	0.00	0.02	3.30	0.06	.14	.10
Spheron N	0.60	96.40	0.00	0.08	2.92	0.23	.16	.20
Philblack E	0.39	96.62	0.26	0.40**	2.33	0.05	.04	.05
Philblack O	0.30	97.95	0.28	0.45**	1.02	0.01	.01	.00
Shawinigan	0.11	99.58	0.06	0.03	0.22	0.02	.09	.05

* All samples were dried for 1 hour in a stream of dry nitrogen at 150°C. before analysis. ** Sulfur contents of unextracted samples run at the same time: Spheron 9, 0.05%; Philblack E, 0.40%; Philblack O, 0.45%. *** Increase in hydrogen content due to extraction and presumably incomplete toluene removal on drying.

stant weight prior to analysis. This increase in hydrogen content on extraction leads to some uncertainty when, in subsequent sections of this paper, we calculate the amount of squalene held on the surface of the samples. However, a careful study of the data leads us to believe that we are justified in neglecting the hydrogen increase due to toluene extraction in such calculations. Some experiments which bear upon this problem are mentioned in following paragraphs (Cf. Table IIb). At any rate the conclusions in this paper would be altered only in degree but not in kind by our choice of the base analyses (Table Ia, Ib or Ic).

Treatment with Squalene

Since our model system is based on the use of squalene, the first set of data illustrates the changes in composition following treatment of the various carbon blacks with squalene. Five grams of carbon black was heated with 10 grams of squalene at 150°C. for one hour followed by a 30-day extraction with toluene, vacuum drying for one hour at 150°C. and finally nitrogen drying at 150°C. for one hour. The analyses of these samples are listed in Table IIa. No very significant change in the sulfur contents was observed, but the hydrogen contents of the samples were definitely increased. There is a general proportionality between the increases in hydrogen contents, Δ%H, and the surface areas of the carbon black samples, as shown in Figure 2. If the increase in hydrogen content is due to squalene held on the carbon black surface as "bound squalene", analagous to bound rubber, we can calculate the amount of squalene which the Δ%H values represent. These values are listed in Table IIa.

An indirect attempt was made to determine whether we were justified in using the most recent analyses, Table Ib, to calculate the hydrogen increase (Δ%H) due to the presence of squalene on the carbon black. Three of the samples were extracted with toluene for 30 days before treating them for one hour with squalene at 150°C. They were again extracted with toluene, this

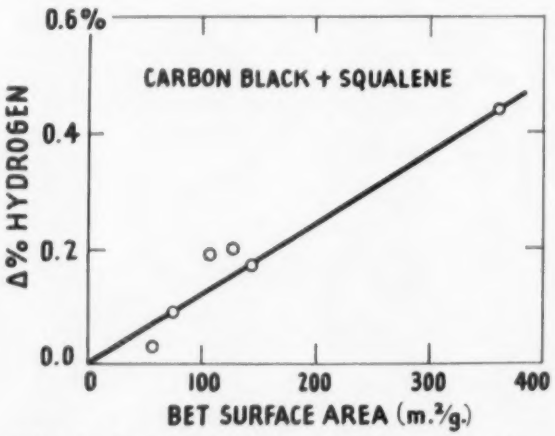


FIG. 2—Increases in hydrogen contents of carbon blacks of various surface areas when treated with squalene followed by extraction and drying.

TABLE IIa—ANALYSES OF CARBON BLACK SAMPLES AFTER TREATMENT WITH SQUALENE, EXTRACTION FOR 30 DAYS AND DRYING

Sample	%H	%C	% Ash	%S	%O (By Diff.)	Hydrogen Increase (Δ %H)	Calcd. % "Bound Squalene"	Area of Surface per Squalene Molecule
Spheron 9	0.90	95.42	0.02	0.05	3.61	0.19	1.65	449 $(A^\circ)^2$
Spheron 6	0.75	96.02	0.08	0.06	3.09	0.20	1.71	519
Spheron N	0.81	96.18	0.04	0.07	2.90	0.44	3.70	666
Philblack E	0.51	96.56	0.31	0.36	2.26	0.17	1.42	676
Philblack O	0.40	97.87	0.32	0.43	0.98	0.09	0.76	671
Shawinigan (Acetylene Black)	0.12	99.75	0.04	0.06	0.03	0.03	0.25	1600

time for 25 days, and vacuum dried for 48 hours at 146°C., and then for one hour in dry nitrogen at 150°C. prior to analysis. The data in Table IIb show that the Δ%H values were close to those in Table IIa. (The vacuum drying of the samples in Table IIb was considerably longer than for the samples in Table IIa). Hence, toluene extraction did not materially alter the Δ%H values. This is considered to be some justification for using the data in Table IIb in our calculation.

Treatment with Sulfur

Elsewhere *(7)* we have reported that sulfur combines with carbon black under conditions of time and temperature which are common during vulcanization. Experience with this reaction indicates that duplicability is difficult to achieve. The analyses in Table III are average values for two independent series of samples, prepared under identical conditions. One gram of carbon black was heated for one hour at 150°C. with ten grams of sulfur. The samples were then toluene extracted for 30 days, and dried first under vacuum and finally in dry nitrogen for one hour at 150°C. just prior to analysis. The results in Table III, and others of a similar nature, suggest that the amount of sulfur which will combine with a particular carbon black when they are heated together for a given time increases with both its surface area and hydrogen content. The oxygen content of the carbon black apparently reduces the amount of sulfur with which it combines. In Figure 3 the increase in sulfur content (Δ%S) is plotted against the product of the hydrogen content and the surface area of the samples. The channel type carbon blacks have the highest oxygen contents and combine with somewhat less sulfur than would be expected from their hydrogen contents and surface areas; however, the accuracy of the data is probably not high enough to justify extended analytical treatment.

During the treatment of carbon black with sulfur [purified according to Bacon and Fanelli *(8)*] hydrogen sulfide is evolved, indicating that some dehydrogenation of the carbon black is taking place. Only a trace of hydrogen sulfide was evolved when the purified sulfur was heated alone. When carbon black was treated with boiling sulfur for 30 days and extracted for 30 days with toluene, most of the samples decreased in hydrogen content. *(9)* This is further evidence that the hydrogen content of the carbon black is involved in its reaction with sulfur.

TABLE IIb—ANALYSES OF CARBON BLACK SAMPLES AFTER 30 DAY TOLUENE EXTRACTION FOLLOWED BY SQUALENE TREATMENT, A SECOND (25 DAY) TOLUENE EXTRACTION AND DRYING

Sample	%H	%C	% Ash	Hydrogen Increase (Δ%H)
Spheron 9	0.88	94.82	0.01	0.17
Spheron N	0.77	95.87	0.04	0.40
Philblack E	0.49	96.53	0.32	0.15

Treatment with Squalene Plus Sulfur

It was previously indicated that when carbon black was heated with squalene the amount of squalene irreversibly held on the surface of carbon black sample is directly proportional to its surface area. When the carbon black was heated with sulfur, the amount of sulfur which was irreversibly held on the surface apparently increased with the product of the hydrogen content and surface area of the sample, but was reduced somewhat by its oxygen content. In studying the incremental effects of the ingredients of our model "reinforced-squalene-vulcanizate" the next step was to heat the car-

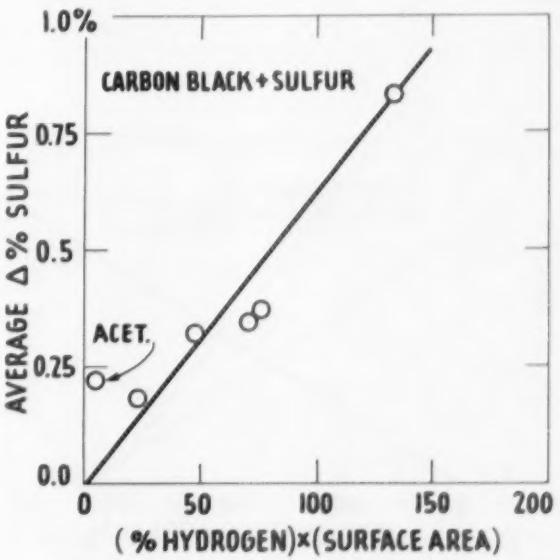


FIG. 3—The relationship between the increase in sulfur content and the product of the hydrogen content and surface area of the carbon black samples.

TABLE III—ANALYSES OF CARBON BLACK SAMPLES AFTER TREATMENT WITH SULFUR FOR 1 HOUR @ 150°C., TOLUENE EXTRACTION FOR 30 DAYS AND DRYING

(The values represent the average of two separate series of preparations.)

Sample	%H	%C	% Ash	%S	%O (By Diff.)	Sulfur Increase (Δ%S)	Hydrogen Increase (Δ%H)
Spheron 9	0.81	94.67	0.17	0.40	3.95	0.37	0.10
Spheron 6	0.66	95.31	0.30	0.34	3.39	0.34	0.11
Spheron N	0.63	93.89	1.42	0.85	3.21	0.83	0.26
Philblack E	0.42	96.21	0.44	0.72	2.21	0.32	0.08
Philblack O	0.36	97.15	0.58	0.63	1.28	0.18	0.05
Shawinigan	0.16	98.56	0.88	0.22	0.18	0.16	0.07

bon black samples with squalene and sulfur. The weights of the ingredients correspond to a formula weight of: squalene, 100; carbon black, 50; sulfur, 3.00.

Table IV contains the analyses of these samples after treatment with squalene and sulfur, 30-day toluene extraction, vacuum drying at 80°C., followed by another drying for one hour in dry nitrogen at 150°C. prior to analysis. The amount of squalene irreversibly taken up by the samples, as measured by the Δ%H values, was again proportional to the surface area of the carbon blacks shown in Figure 4. The Δ%H values in Tables II and IV do not appear to be significantly different.

As shown in Figure 5, the amount of sulfur which was irreversibly taken up by the samples was again roughly proportional to the product of their hydrogen contents and surface areas with somewhat lower values for the high oxygen blacks. However, in the experiments in which squalene was present, the amount of sulfur found in a given sample was reduced by a factor of 2.8, as indicated in Figure 6. This is not surprising because the concentration of sulfur was quite different in the two experiments. Furthermore, squalene would also be expected to compete with the carbon black for the sulfur. Only a minor portion of the squalene present was retained by the carbon black after extraction. It is not known, of course, how much sulfur is combined exclusively with the carbon black, exclusively with the squalene, or in sulfur bridges between the two.

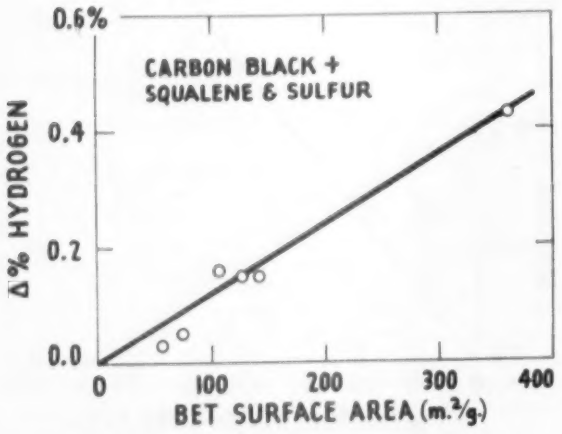


FIG. 4—Increases in hydrogen content of carbon blacks of various surface areas when treated with squalene and sulfur.

Treatment with Squalene, Sulfur, MBT and Laurex

In the next experiments, the rubber accelerator MBT, activated with Laurex (zinc laurate), was added to the model system. Our squalene analogue of a simple reinforced rubber vulcanizate is now complete and the formula weight corresponds to:

Squalene	100.00
Carbon Black	50.00
Sulfur	3.00
MBT	1.00
Laurex	3.00

(The quantities used corresponded to one-tenth the formula weight in grams.)

After heating for one hour at 150°C., toluene extraction for 30 days, vacuum drying at 80°C. and final nitrogen drying at 150°C., the samples were analyzed for carbon, hydrogen, ash, nitrogen, total sulfur, sulfide sulfur and zinc. "Organic sulfur" was calculated by subtracting the sulfide sulfur from the total sulfur. The analyses are presented in Table V.

As previously observed, the amounts of squalene held irreversibly by the carbons was proportional to their

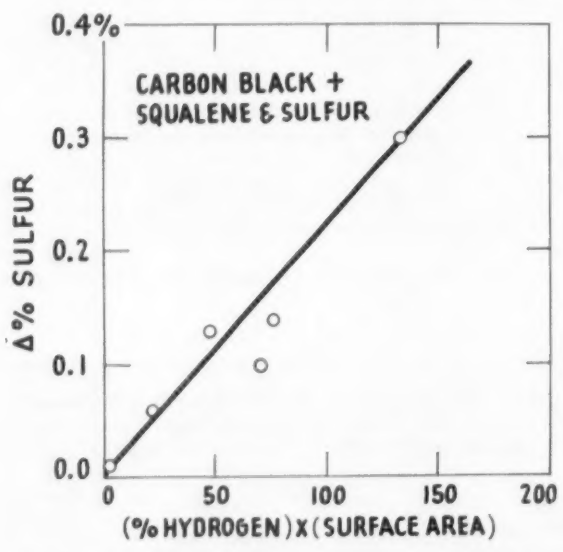


FIG. 5—The increase in sulfur content appears to be directly related to the product of the hydrogen content and the surface area.

Table IV—Analyses of Carbon Black Samples After Treatment with Sulfur and Squalene Followed By Extraction with Toluene for 30 Days, Vacuum and Nitrogen Drying

Sample	%H	%C	% Ash	%S	%O (By Diff.)	Hydrogen Increase (Δ%H)	Sulfur Increase (Δ%S)
Spheron 9	0.87	95.16	0.03	0.17	3.77	0.16	0.14
Spheron 6	0.70	95.64	0.05	0.10	3.51	0.15	0.10
Spheron N	0.80	95.64	0.05	0.32	3.19	0.43	0.30
Philblack E	0.49	96.34	0.33	0.53	2.31	0.15	0.13
Philblack O	0.36	97.76	0.37	0.51	1.00	0.05	0.06
Shawinigan	0.12	99.59	0.11	0.07	0.11	0.03	0.01

surface areas, as shown in Figure 7. The increase in organic sulfur is plotted against the product of the hydrogen content and the surface area in Figure 8. The straight line representing the relationship between these variables does not intersect the origin. This may possibly be due to the presence of sulfur in combination with zinc in a form which is insoluble in toluene (other than zinc sulfide). Or it might be due to combination of sulfur with the squalene. If the carbon black activated the accelerator which in turn reacted with sulfur to produce free sulfur radicals, these could combine with the squalene held on the surface of the carbon black. Note that even though the product of the hydrogen content and the surface area of Shawinigan is quite small, there is still a surface of 58 square meters per gram which contains a calculated amount of irreversibly bound squalene of 0.64% of the weight of the sample. This, however, would correspond to 4.6 sulfur atoms per squalene molecule, a very high figure! Additional discussion of the sulfur analyses will be presented later in another section of this article.

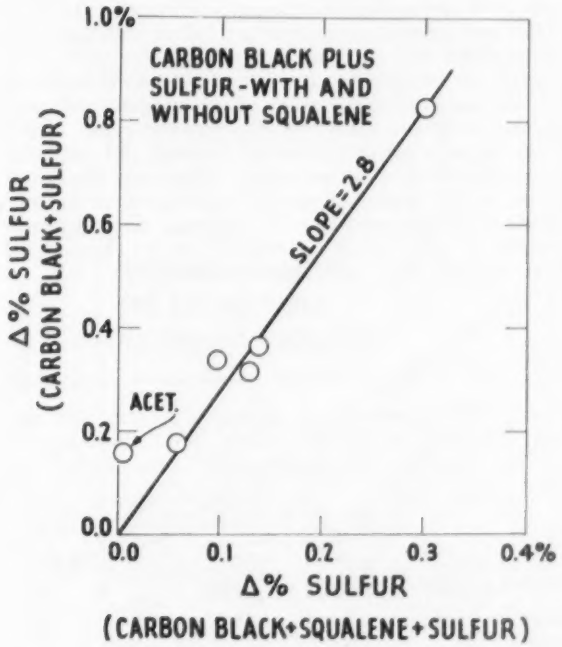


FIG. 6—The increases in sulfur contents are larger in carbon black-sulfur systems than in carbon black-sulfur-squalene mixtures.

Treatment with Sulfur, MBT and Laurex (without Squalene)

To complete the present study, a series of mixtures containing carbon black, sulfur, MBT and Laurex—without squalene—were treated for one hour at 150°C., extracted 30 days with toluene, vacuum and nitrogen dried and analyzed for total sulfur, sulfide sulfur, and zinc. The data are presented in Table VI. The weights of the ingredients in the mixture were: carbon black, 5.00 g.; sulfur, 20.00 g.; MBT, 0.10 g.; Laurex, 0.30 g.

Discussion and Conclusions

(1) One of the most striking features of this investigation is the constancy of the hydrogen contents of the squalene treated samples whether the treatment was conducted in the presence or in the absence of curing agents for rubber. This is shown in Table VII. The data indicate that within the experimental error the amount of squalene which is associated with the carbon black after extraction is not affected by the presence of sulfur or sulfur and accelerator.

It is unfortunate that there is uncertainty in the hydrogen content of the carbon black associated with the squalene because this "base" point is necessary to calculate the amount of squalene associated with the carbon black. The "original" analyses listed in Table Ia and the analyses of the toluene extracted samples shown in Table Ic, almost unquestionably represent the limits of this uncertainty. However, as was mentioned previously, we believe we are justified in using as base analy-

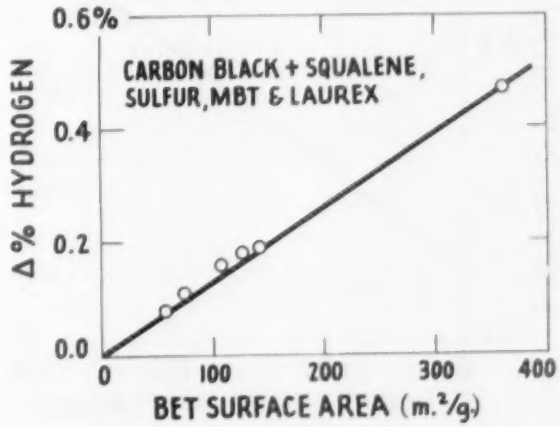


FIG. 7—Increases in hydrogen content of carbon blacks of various surface areas when treated with squalene, sulfur, MBT and Laurex.

TABLE V—ANALYSES OF CARBON BLACK SAMPLES AFTER TREATMENT WITH SQUALENE, SULFUR, MBT AND LAUREX, 30 DAY TOLUENE EXTRACTION AND DRYING

Sample	%H	%C	% Ash	%S (Total)	%N**	%O (By Diff.)	% Sulfide Sulfur	Increase in % Organic Sulfur (Δ% "Org." S)	% Zinc	Hydrogen Increase (Δ%H)
Spheron 9	0.87	93.47	1.15	0.74	.13	3.64	0.10	0.61	0.84	0.16
Spheron 6	0.73	93.92	1.14	0.70	.09	3.42	0.14	0.56	0.88	0.18
Spheron N ...	0.84	93.53	1.13	1.17	.13	3.20	0.14	1.01	0.83	0.47
Philblack E ..	0.53	94.63	1.36	1.15	.08	2.25	0.26	0.54	0.86	0.19
Philblack O...	0.42	97.84	1.38	1.05	.09	(—0.78)*	0.28	0.34	0.85	0.11
Shawinigan ..	0.17	97.89	1.25	0.59	.16	(—0.06)*	0.30	0.23	0.82	0.08

* These values are obviously in error; the carbon values are believed to be high. ** Sealed tube Kjeldahl. These values are the average of two determinations, none of which varied by more than ±0.02%.

ses the values in Table Ib. and the average hydrogen increases calculated on this basis are shown plotted against the surface areas of the samples in Figure 9.

(2) At this point there is no evidence to indicate that the squalene is held to the carbon surface by sulfur linkages. The considerations in item (1) of this section indicate that it is not necessary to assume such sulfur bridges are present. On the contrary, the constancy of the Δ%H values for various mixtures when heated for one hour at 150°C. would lead us to suspect that some mechanism other than sulfur bridges is responsible for binding the squalene to the surface.

It seems possible for a neutral hydrogen atom to dissociate from a squalene molecule forming a free radical, both of which could react with the carbon black. This would presumably tie the squalene molecules to the carbon black surface by carbon-to-carbon bonds. Garten and Sutherland *(6)* and Watson *(5)* have demonstrated that carbon black can act as a free radical acceptor. According to this explanation if sulfur bridges are formed between the carbon black particle and the squalene molecule, this type of chemical linkage would presumably take place in addition to the carbon-to-carbon bonds.

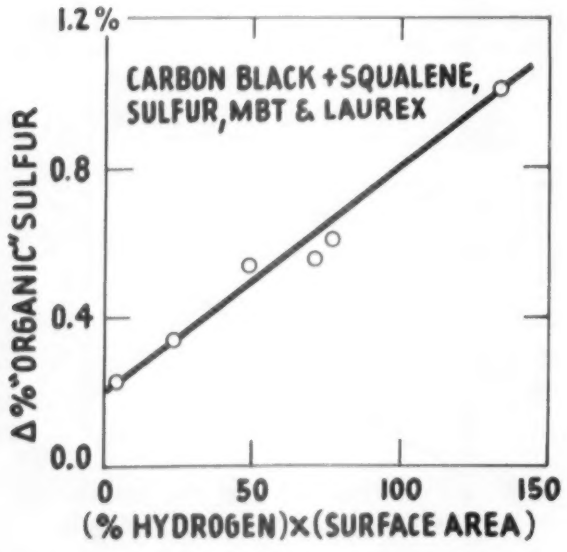


FIG. 8—The increase in organic sulfur is dependent upon both the hydrogen content and surface areas of the various carbon blacks.

(3) In this study most of the data were obtained by heating the mixtures for one hour at 150°C. Taken alone, the data obtained under these conditions with the squalene-carbon black-sulfur system would indicate that there was a direct proportionality between the increase in sulfur and hydrogen contents of the samples, as illustrated by Figure 10. However, a time study indicates that this proportionality, as shown in Figure 11, is fortuitous. The data plotted in this latter figure seem to indicate that the two processes are taking place more or less independently.

(4) The influence of the accelerator system in increasing the reactivity of the sulfur is shown in Figure 12. The amount of sulfur found in the extracted solids removed from the carbon black-squalene-sulfur-MBT-Laurex system was considerably greater than found in the extracted solids removed from the carbon black-squalene-sulfur system.

(5) Another point of considerable interest is shown in Figure 13. Here are plotted the increase in total sulfur content of the carbon black samples treated with sulfur, MBT and Laurex against those treated with *squalene*, sulfur, MBT and Laurex. In spite of a tremendous difference in sulfur concentration, the total increases in sulfur contents of the two sets of extracted samples were identical within the probable experimental error. Likewise, the presence or absence of squalene did not influence these total sulfur increases. However, the distribution of the sulfur is markedly different in the two systems. When squalene is present, a considerable amount of zinc sulfide is found. In the absence of squalene, very little sulfide is formed.

TABLE VI—ANALYSES OF CARBON BLACK SAMPLES AFTER TREATMENT WITH SULFUR, MBT AND LAUREX, 30 DAY TOLUENE EXTRACTION AND DRYING

Sample	% S (Total)	% Sulfide Sulfur	Increase in % "Organic" Sulfur	% Zinc
Spheron 9	0.75	0.02	0.70	0.42
Spheron 6	0.80	0.04	0.76	0.38
Spheron N	1.16	0.03	1.11	0.51
Philblack E	1.11	0.10	0.61	0.50
Philblack O	1.05	0.16	0.44	0.59
Shawinigan	0.04*	0.11	—	0.39

* This value appears to be in error.

TABLE VII—SUMMARY OF HYDROGEN INCREASES IN SYSTEMS CONTAINING SQUALENE
(1 HOUR HEATING AT 150°C.)

Sample	Hydrogen Content	Increase In Hydrogen Content During Treatment: Carbon Black Plus Squalene	Carbon Black Plus Squalene and Sulfur	Carbon Black Plus Squalene, Sulfur MBT and Laurex	Average Δ%H	Area Per Squalene Molecule
Spheron 9	0.71%	0.19%	0.16%	0.16%	0.17%	492(A)*
Spheron 6	0.55	0.20	0.15	0.18	0.18	560
Spheron N	0.37	0.44	0.43	0.47	0.45	621
Philblack E	0.34	0.17	0.15	0.19	0.17	669
Philblack O	0.31	0.09	0.05	0.11	0.08	758
Acetylene	0.09	0.03	0.03	0.08	0.05	957

In the absence of squalene, the only sources of hydrogen for the production of hydrogen sulfide are the hydrogen contents of the carbon black, MBT and zinc laurate. When squalene is present, a considerable amount of hydrogen sulfide is formed, probably largely by the reaction between sulfur and the alpha-methylene hydrogen atoms of the squalene. The amount of sulfide sulfur produced was increased several fold when the MBT and Laurex were added to the carbon black-sulfur-squalene system.

The equivalence of the total Δ%S values in the two systems (carbon black-squalene-sulfur-MBT-and-Laurex and carbon black-sulfur-MBT-and-Laurex) is in accord with the current ideas on accelerator action, namely, that the accelerator functions by making sulfur available in a more reactive form. Gordon *(10)* suggested that accelerators function by opening the S_8 rings which would result in the formation of free sulfur radicals. Craig, et al *(11)* believe the active radicals to be •SS•.

(6) The amount of sulfide sulfur found in either of the two systems discussed in (5), above, is influenced by the oxygen content of the carbon black, as indicated in Figure 14. The higher the oxygen content of the carbon black, the lower the sulfide sulfur values.

A more extensive study of the phenomena associated with hydrogen sulfide formation was presented in the second paper in this series (RUBBER AGE, February, 1957) under the title, "Scorch in Natural Rubber Stocks Containing Carbon Black". In this paper it was shown that (a) hydrogen sulfide formation was catalyzed by carbon black, an effect which is proportional to the carbon black surface; (b) this catalytic reaction was suppressed by the oxygen content of the carbon black, most likely by the quinone type oxygen present on the surface *(12)*; (c) hydrogen sulfide probably adds to the quinones by 1,4 addition. *(13, 14, 15)*; and (d) in the presence of oxygen, carbon is a catalyst in the oxidation of hydrogen sulfide to sulfur. *(16)*

(7) There is evidence in the data presented here that there is a high level of chemical activity at or near the carbon black surface. A substantial portion of the sulfur which was added to the system was found in the extracted samples, as inspection of the tables show. In no case was the squalene concentration, as judged by the Δ%H values, over 4% of the weight of the carbon black. This would correspond to not over 2% of the squalene present in the system. Yet Δ%S values as high as 1.15% (Table V, Spheron N) would correspond to roughly 17% of the sulfur added to the mixture as sulfur and accelerator. And free sulfur determinations on the liquid fractions of the carbon black-squalene-sulfur-MBT-Laurex mixtures indicated that about one-third of the sulfur had not reacted.

The nitrogen increases listed in Table V could only have come from the accelerator (MBT). These nitrogen increases correspond to a substantial portion of the nitrogen which was added to the mixture as MBT. They range from 45% for Philblack E to 90% for Shawinigan of the nitrogen content of the MBT which was added to the mixture! This does not mean that the MBT molecules remain adsorbed or inert at the surface. It is en-

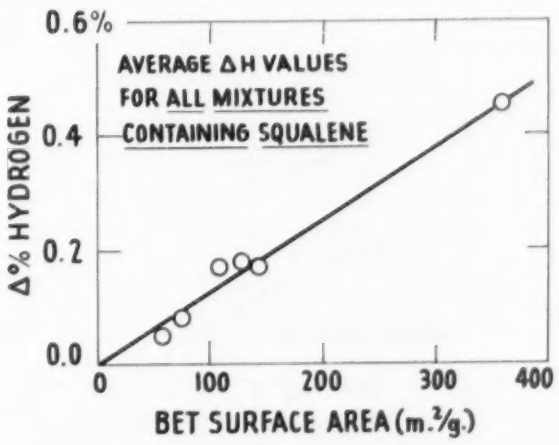


FIG. 9—Analysis of the increases in hydrogen content for all squalene containing mixtures.

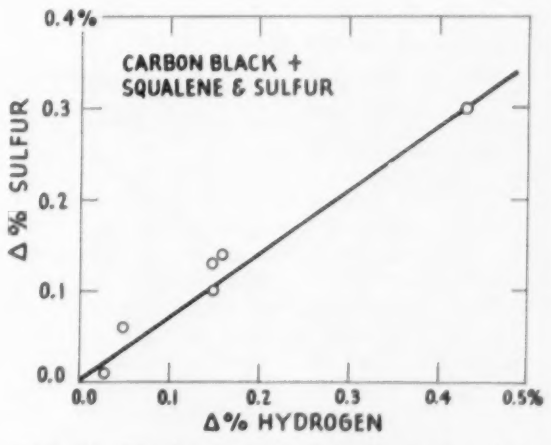


FIG. 10—The increases in sulfur contents and the increases in hydrogen contents of various carbon blacks treated with squalene and sulfur.

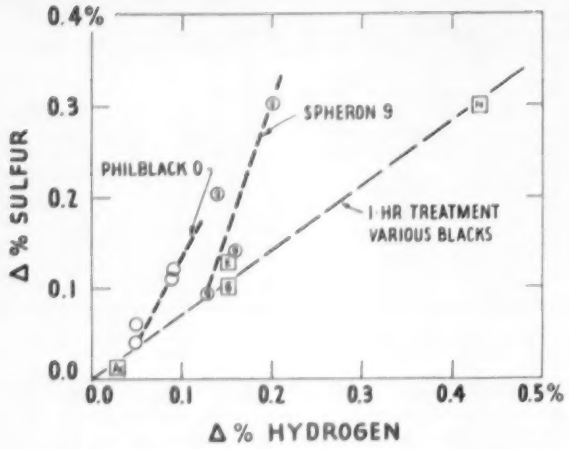


FIG. 11—Trend of Δ% sulfur and Δ% hydrogen values with increased time of treatment at 150°C. carbon black-squalene-sulfur.

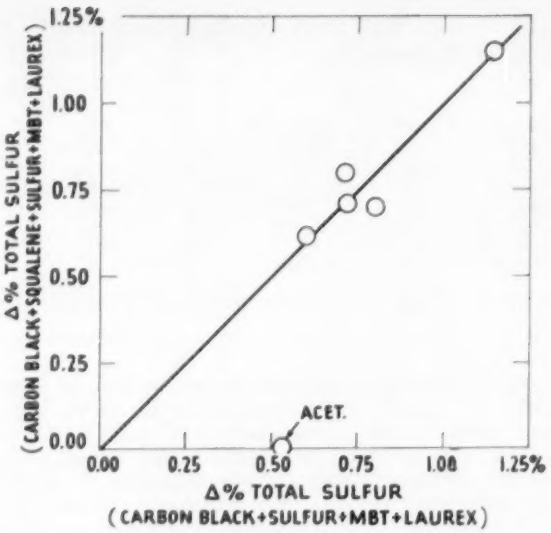


FIG. 13—Increase in total sulfur contents—carbon-black-sulfur-MBT-Laurex mixtures with and without squalene.

tirely possible that the accelerator was chemisorbed with dissociation into fragments which were active in accelerating the sulfur. Furthermore, the zinc contents of the samples in Table V are considerably higher than they would be if all the zinc were present as zinc sulfide. Auerbach *(17)* has shown that the zinc salt of mercaptobenzthiazole is the initial product formed from MBT during vulcanization of rubber. However, the solubility of the zinc salt of mercaptobenzthiazole in toluene, although small, is high enough so we would expect it to be removed during the 30-day extraction. Furthermore, neither chloroform nor acetone (in which it is much more soluble) would remove the nitrogen from one of the samples during a seven-day extraction. Moreover, stoichiometric calculations indicate that more zinc is present than can be accounted for as the zinc salt of mercaptobenzthiazole.

(8) The acetylene black, Shawinigan, gave erratic results in some of these systems. Part of this was due to an experimental difficulty which resulted from the large quantities of sulfur or squalene required to produce fluid mixtures with this sample. This probably caused erratic heat transfer into some of the mixtures. However, the high nitrogen value in Table V and the high sulfur values in some of the experiments cannot be explained in this manner. Difficulty was also experienced in our attempts to analyze the oxygen-containing groups by diazomethane analysis *(12)* where high values were found for this sample. Acetylene black frequently displays chemical reactivity which is greater than would be predicted from its hydrogen and oxygen contents.

(9) In presenting this study an attempt has been made to show relationships between certain fundamental properties of the carbon black samples and these model systems. It has been necesary to be a bit arbitrary in our choice of variables for this correlation. It is not easy to decide which of the many possible combinations of properties is responsible for the effects which are observed, and it is hoped our choice has been reasonable.

(Continued on page 1083)

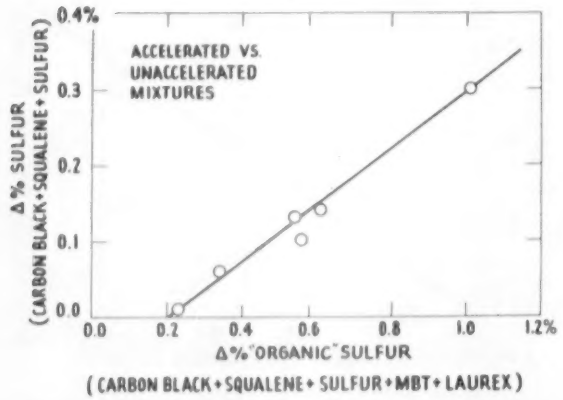


FIG. 12—The influence of accelerator on the amount of organically combined sulfur.

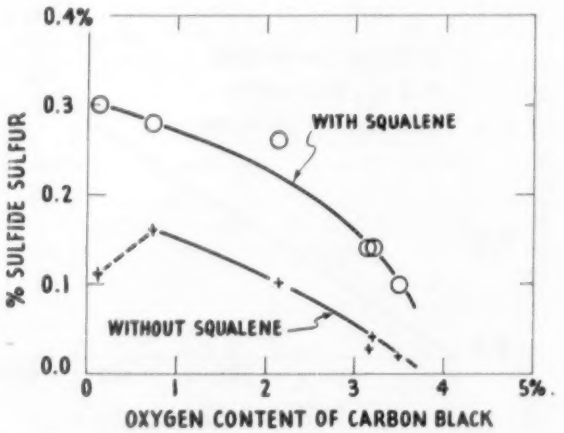


FIG. 14—Sulfide sulfur formation—carbon black-sulfur-MBT-Laurex mixtures with and without squalene.

Editorials . . .

Chemistry Problems

IN an attempt to assess the contributions which chemical technology can be expected to make in the future, the editors of the *Du Pont Magazine* recently asked research directors to name the major problems in their industries that chemistry can help solve in whole or in part. The research directors came up with a list which should keep the laboratory lights burning for years to come. Among the problems put forth were several having specifically to do with the rubber and the rubberlike plastics industries. A food company, for example, observed that there is a need for plastic films having special characteristics such as impermeability to oxygen, water, etc., along with physical characteristics permitting use over a wide temperature range such as —50 to +300°F.

A manufacturer of air conditioning equipment urged that structural inflated panels be developed further with emphasis on the refinement of foamed plastic insulation cores. He also urged the development of practical economical foamed-in-place plastic insulation. In the area of insulation, notably in freezers and refrigerators, it was noted that a substantial improvement in K factor is needed.

Improvement in the abrasion resistance of rubbers and plastics was asked for by one plumbing manufacturer who also recognized a need for an increase in the temperature and pressure ranges over which plastics may be utilized. A manufacturer of building supplies declared that most of the material problems in research and development come about when one attempts combinations of aluminum, for example, with rubbers, plastics and fibrous materials.

A railroad company stated that there is a definite need for the further development of insulating materials, particularly for electrical equipment. It was emphasized that greater insulating qualities are desired so that the equipment will be better able to withstand moisture, heat, and other natural causes of deterioration. A shipbuilder called for insulation materials for electric cable which will permit handling in Winter. He claimed that present cables cannot be installed at temperatures below 40°F. He also asked for a trowelled deck covering of uniform color, adequate elasticity to allow for vibration, and having a coefficient of thermal expansion close to that of steel and resistant to scrubbing and water.

Better adhesives for metal-to-metal and metal-to-plastic were asked for by many manufacturers who would like to use such adhesives where they now "weld, rivet, screw, bolt, tack or solder." Other manufacturers are looking to chemistry for containers that will do all the things that cans and jars do today. Plastic materials that would form a film coating on foods by dipping were asked for by food packagers.

Only recently, the National Inventors Council published a listing of technical problems affecting national defense—problems which, when solved, will materially aid the defense effort. The Council states that in the field of meteorological balloon development, there is a need for a compound for use in fabricating the balloons which will permit assents to an altitude of 125,000 to 150,000 feet with a payload of 1700 grams.

The Council advises that there is also a need for a battery sealing material, one which will effectively prevent moisture loss over a temperature range of —65 to +160°F. It was also pointed out that there is a demand for new metal-to-metal bond inspection techniques. What the Council is looking for here is a means of inspecting structural joints formed by bonding the components with current bonding agents.

It may be that these "problems" as set forth by representative industries are in the nature of a "large order". Certainly, these problems are not insolvable, they are dependent only upon the time and energy which the researchers can devote to them. These "problems" also bring to mind the fact that there are always new horizons, always new challenges to our ingenuity and resourcefulness which lend interest to our daily affairs.

Capitol Cues

WITH this issue we begin publication of new and exclusive reports from the nation's capital covering legislative, economic and political developments which have bearing on the general economy of our country. While RUBBER AGE has always provided complete coverage of those specific political and economic developments affecting the rubber industry, this new series of reports will provide new focus and more comprehensive coverage than was heretofore possible. In these days when governmental action bears so strongly on the conduct of day-to-day business, this new feature will prove an invaluable aid in planning ahead and in understanding the business climate. Look for "Capitol Cues" beginning in this issue!

Highlights Sidelights *of the News . . .*

March, 1957

A Federal Court of Appeals has thrown out the Federal Trade Commission rule against quantity discounts on tire and tube purchases of more than 20,000 pounds a rail car load . . . The court stated that the FTC limit was established without the factual basis called for by the Robinson-Patman and Clayton Acts . . . The decision left the way open for another FTC attempt to limit discounts to 20,000 pounds but made it clear that such action must be based on a finding that possible purchasers at the higher levels are scarce (page 1037).

Backed by twenty-four producing, packing and consuming organizations in thirteen countries, the Rubber Manufacturers Association has begun world-wide distribution of a new set of natural rubber standards aimed at vastly improving the quality of the many grades of this raw material moved in international trade . . . The new standards embrace the thirty-six grades of natural rubber which account for the bulk of international trade (page 1041).

Members of the Seiberling family have signed an agreement with Edward Lamb to vote all Seiberling common stock owned by both parties for a joint slate of directors at the company's annual meeting of shareholders on April 22 . . . The agreement was made to avoid any need for separate solicitation of proxies . . . Seiberling Rubber's charter provides cumulative voting rights which entitle Mr. Lamb to representation on the board of directors in proportion to his stock ownership (page 1037).

Goodrich has announced the successful vulcanization of an automobile tire through the use of atomic energy . . . In addition to proving the practicability of vulcanizing large items by nuclear radiation, the experiment is said to have produced a tire expected to wear longer and resist deterioration better than conventionally vulcanized tires (page 1038).

ASTM has announced the formation of a new committee on cellular rubbers which will include representatives from Committee D-11 on Rubber and Rubberlike Materials . . . The new committee, the Coordinating Committe on Cellular Materials, will attempt to bring together divergent activities on cellular materials now handled by several different groups (page 1044).

Goodyear reports that its 1956 net earnings of $62,456,130 have set an all-time high (page 1052) . . . Consolidated sales of General Tire for the year ended November 30, 1956, have reached a new high of $390,471,772 (page 1053) . . . Goodrich profits for 1956 have dropped reflecting a 4.1 per cent decrease in sales (page 1052).

NEWS REPORTS and Industry Activities

FTC QUANTITY DISCOUNT RULE THROWN OUT BY FEDERAL COURT

A Federal Appeals Court has thrown out the Federal Trade Commission rule against quantity discounts on tire and tube purchases of more than 20,000 pounds a rail car load. Upholding an earlier decision of a Federal District Court, the U. S. Court of Appeals for the District of Columbia said the FTC limit was established without the factual basis called for by the Clayton and Robinson-Patman Acts. The decision was a victory for 19 of the nation's tire manufacturers and marketers, including virtually every major producer.

Circuit Judge Wilbur K. Miller, who delivered the unanimous decision of the three-man court, reminded the FTC that the law provides for the creation of a 20,000 pound ceiling on tires and tubes only where available purchases are 'so few" as to render a discount on larger quantities "unjustly discriminatory or promotive of monopoly in any line of commerce." The FTC order, he said, was not based on the number of such purchasers buying in 20,000-plus amounts but, rather, on the number of purchasers with annual dollar volumes greater than $600,000.

Defines Commission Powers

Judge Miller said the commission "chose to make a finding concerning the paucity of available purchases in quantities greater than a certain annual dollar volume, and then fixed a quantity limit in terms of a carload". The commission has no power to fix and establish quantity limits, he ruled, unless it first makes a finding on the number of purchasers available to buy more than 20,000 pounds at a time.

His decision covered the following producers or marketers named in the FTC appeal to the court: the B. F. Goodrich Tire & Rubber Co., the General Tire & Rubber Co., the Goodyear Tire & Rubber Co., Firestone Tire & Rubber Co., Allied Tire & Battery Co., U. S. Rubber Co., Inland Rubber Corp., Pacific Tire & Rubber Co., Denman Rubber Mfg. Co., Mansfield Tire & Rubber Co., Carlisle Corp., Durkee-Atwood Co., Seiberling Rubber Co., Dunlop Tire & Rubber Co., Missouri Farmers Association, Western Auto Co., Montgomery Ward, Dayton Rubber Co., Lee Rubber & Tire Co., and American Oil Co.

The Appeals Court decision left the way open for another FTC attempt to limit discounts to 20,000 pounds but made it clear that such action must be based on a finding that possible purchasers at the higher levels are scarce.

I.R.I. Conference Postponed

In order not to conflict with the forthcoming International Rubber Conference which will be held in the week of November 8, 1959, in Washington, D. C., the Institution of the Rubber Industry, London, England, has decided to postpone its Fourth Rubber Technology Conference until 1962. G. E. Holmes-Siedle, secretary of I.R.I., in response to an invitation from the International Conference Committee, has advised that a delegation from his organization will be formed to attend the International Rubber Conference.

Expanding Lining Facilities

Plastic Applicators, Inc., Houston, Texas, has undertaken a $500,000 program to increase services to the oil, petrochemical, refinery and pulp and paper industries in the southwestern area. Included in the program are the construction of a new $50,000 general office building and a complete new plant for the compounding, manufacture and application of sheet rubber linings and coverings for protection of storage and handling equipment for corrosive gases, liquids or vapors. The latest types of rubber compounding and milling equipment will be installed at the new plant, which will be operated by Rubber Applicators, Inc., a subsidiary of Plastic Applicators.

SEIBERLING AND LAMB AGREE ON JOINT DIRECTORS' SLATE

J. P. Seiberling, president of the Seiberling Rubber Co., Akron, Ohio, and other members of the Seiberling family, have signed an agreement with Edward Lamb, both as an individual shareholder of Seiberling and as head of Edward Lamb enterprises, Inc., to vote all Seiberling common stock owned by both parties for a joint slate of directors at the company's annual meeting of shareholders on April 22.

The agreement was made to avoid any need for separate solicitation of proxies by the two groups, with the consequent additional expense and disruption of normal company business. Seiberling's charter provides cumulative voting rights, which entitle Mr. Lamb to representation on the board of directors in proportion to his stock ownership.

Fifteen Candidates Nominated

The Seiberling board has nominated a common slate of 15 candidates for membership on the 1957 board, consisting of all present directors. These nominations will appear in the company's proxy statement to be mailed to shareholders about March 21.

Both Mr. Lamb and the Seiberling family have agreed to vote all stock held by them at the annual meeting in favor of the joint slate. Directors on the slate include: A. C. Blinn, L. M. Buckingham, P. A. Frank, C. E. Jones, Mr. Lamb, J. Howard McGrath, Frank C. Oswald, H. E. Paige, M. H. Pendergast, H. P. Schrank, J. P. Seiberling, L. M. Seiberling, W. P. Seiberling, T. Tyler Sweeny, and R. J. Thomas.

The agreement also stipulates that if any member of the slate is unable to serve, or withdraws prior to the vote at the meeting, the proxy committee will nominate a substitute, and both groups will vote as though the substitute were the original slate.

Starting this month, a new two-page feature reporting on happenings in Washington, D. C. Designed to give greater insight into the national political and economic scene, the new feature, "Capitol Cues", will be a valuable aid to business planning. (See page 953).

GOODRICH VULCANIZES TIRE THROUGH NUCLEAR RADIATION

B. F. Goodrich Co., Akron, Ohio, has announced that for the first time atomic energy has been successfully used to vulcanize an automobile tire. The company's scientists said they believe the tire is the first large commercial item ever processed by nuclear radiation and the first basic change in the "curing" of rubber products since the discovery of vulcanization in 1839. In addition to proving the practicability of vulcanizing large items by nuclear radiation, the experiment produced a tire expected to wear longer and resist deterioration better than conventionally-vulcanized tires, the scientists said.

Vulcanization, they explained, normally involves adding sulfur and other chemicals to rubber and heating it. Until it is vulcanized, rubber is a relatively useless material, sticky in hot weather, brittle in cold and susceptible to rapid deterioration. Nuclear vulcanization of the tire was achieved without the use of heat, and no sulfur or accelerators, standard components of all of today's vulcanization processes, were used. The scientists said the nuclear vulcanization resulted in a direct linkage of the carbon atom chains of the rubber molecules. Ordinarily, the carbon atom chains are linked through sulfur atoms, and this is the "weak link" in vulcanized rubber, they said.

Better Aging Resistance

Tests show the nuclear vulcanized tire to have considerably better resistance to aging and deterioration than conventionally vulcanized tires while the tread shows "above normal" resistance to abrasion and wear, the scientists said. The company said the achievement proved that in the future, if nuclear energy becomes economically practical, tires could be vulcanized "cold" on a production basis much more rapidly than they are with today's processes which require 300-plus degrees. The vulcanization was achieved by Goodrich scientists at the Atomic Energy Commission's National Reactor Testing Station in Idaho.

The tire, in a steel mold, was vulcanized by rotating it slowly over radioactive fuel elements taken from a nuclear reactor. This was done in a 17-foot-deepwater-filled canal at the Materials Testing Reactor Gamma Facility, the water protecting the scientists from exposure to radiation.

In commercial production in the future, vulcanization could be done in a cell with radiation being supplied by machines, or by radioactive by-products from a nuclear reactor, similar to those in the fuel elements used in the Gamma Facility, the scientists said. Commercial development of this and similar processes will turn to practical use these radioactive poisons, the disposal of which is today an important problem in the development of economic atomic power.

The scientists worked out a complete mathematical model of the tire and the radiation system before attempting the vulcanization. This series of equations, which took several weeks to prepare, predicted exactly the end results of the vulcanization, the scientists said.

The first tire, and other radiation-vulcanized tires, will undergo further tests of all types, under all conditions, to evaluate the results of this type of vulcanization. Vulcanization of the tire stemmed from intensive work by Goodrich in the field of high energy radiation dating from 1927. The company at that time succeeded in vulcanizing small samples of rubber by means of high energy electrons and in 1933, was granted a patent on this process.

Heads New Sales Group

H. Herman Abernathy

The Elastomer Chemicals Department of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has established a sales development group under H. Herman Abernathy, to speed commercial development of the department's new products. The group will evaluate new materials to determine their commercial utility, aid in planning and execution of field testing programs, assist in market research activities and sell on a test basis. Mr. Abernathy has had 18 years' experience with DuPont in elastomers work. Other members are Don R. Kuespert, located in the department's Wilmington office; W. Vance Freed, Harold G. Schwartz and M. A. Youker, with headquarters at the Elastomers Laboratory near Wilmington; and Lee R. Eckman, working out of the department's Akron district sales office.

Reports on Current Stockholders

U. S. Rubber Co., New York, N. Y., has announced that common stockholders of the company numbered 25,823 on December 31, 1956, an increase of 919, or 3.17 per cent, over the number a year earlier. The number of preferred stockholders continued to decline, reaching 8,743 at the year-end, a decrease of 3.6 per cent. The decline is due largely to an increase in holdings of the preferred stock by foundations, trusts, funds and similar large holders, the company says. The company has 9,461 more common stockholders now than it did five years ago, an increase of 55 per cent.

SOUTHERN GROUP MEETING FEATURES TWO SYMPOSIUMS

The newly organized Southern Rubber Group held its second meeting on February 8 and 9 at the Statler Hotel in Dallas, Texas, with some 200 members in attendance. The meeting featured two seminars, one on "Processing" and the other on "Reinforcement of Rubber With Fabric." G. H. Boeder (Goodrich) served as moderator for the first seminar which included the following speakers:

Banbury Mixing, C. R. Washburn (Goodyear); *Mill Mixing*, D. H. Cowan (Goodrich-Gulf); *Calendering*, M. M. Baker (Firestone); *Extruding*, R. L. Turpin (Bowling Green Rubber); *Processing Equipment*, R. N. Comes and H. C. Chase (Farrel-Birmingham).

The second seminar was moderated by George Hutchinson (Armstrong Tire) and featured the following speakers: *Utilization of Nylon and Dacron*, Howard Brokaw (DuPont); *Utilization of Rayon*, A. B. Baker (American Viscose); *Utilization of Cotton*, H. R. Schwarz (Wellington Sears);; *Adhesion of Textiles*, L. W. Reeves (General Tire).

Special Ladies' Program

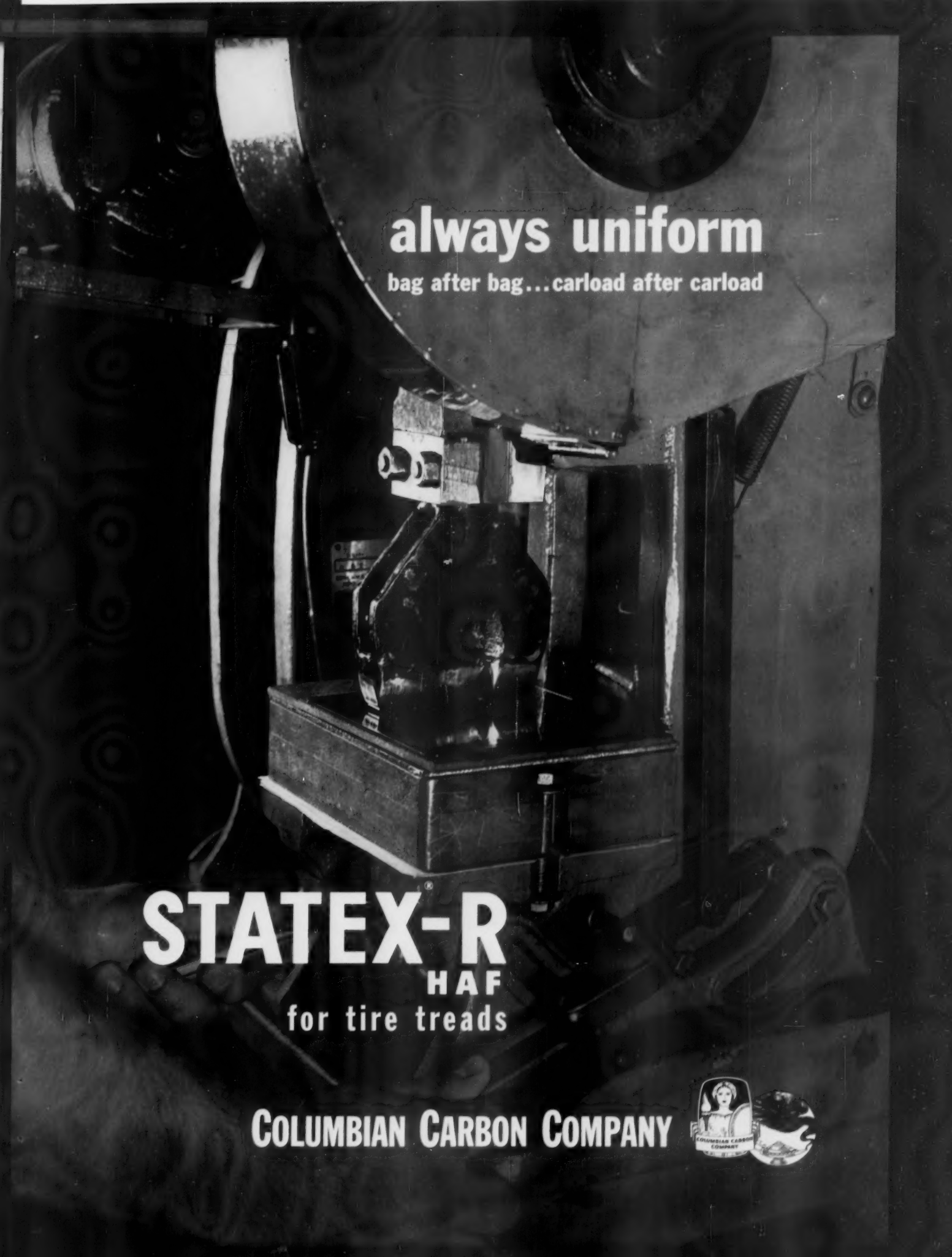
A special program was arranged for the ladies and included a luncheon and style show held at the Neiman-Marcus department store. It was announced at the meeting that John Bolt (Naugatuck Chemical) had been elected chairman of the group by the board of directors to fill the unexpired term of the late Harmon Connell. William Gerrow (Goodyear Chemical) has been elected a director of the group to fill Mr. Bolt's unexpired term.

The next meeting of the group will be held on June 7 and 8 at the Dinkler Plaza Hotel in Atlanta, Ga. Two seminars have been scheduled for this meeting, one covering "Latex Technology", while the other will be devoted to "Antioxidants and Antiozonants."

A subsequent meeting to be held in Memphis, Tenn., on November 15 and 16, will also feature two seminars, one on "Rubber-to-Metal Bonding" and the other on "SQC and Rubber Grading." Subjects to be discussed for a group meeting scheduled for February 21 and 22 in Dallas, Texas, have not yet been decided upon.

Terry Joins Reynolds Chemical

Samuel M. Terry has been appointed manager of product development for Reynolds Chemical Products Co., Ann Arbor, Mich. Mr. Terry, a graduate of the University of Pittsburgh and Vanderbilt, was formerly associated with Pittsburgh Plate Glass, where he served in the research laboratories. Previously, he had been a research engineer at Battelle Memorial Institute and a research fellow at Mellon Institute. A member of the American Chemical Society, he specializes in organo-physical chemistry and plastic technology. He holds numerous U. S. patents on adhesives and synthetic filaments and several patent applications on urethane foams are pending.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NEW RMA TYPE DESCRIPTIONS TO IMPROVE NATURAL QUALITY

Backed by 24 producing, packing and consuming organizations in 13 countries, the Rubber Manufacturers Association has begun world-wide distribution of a new set of natural rubber standards aimed at vastly improving the quality of the many grades of this raw material moved in international trade. The booklet is entitled "Type Descriptions and Packing Specifications for Natural Rubber Grades Used in International Trade." It embraces the 36 grades of rubber which account for the bulk of international trade in dry rubber.

The new document supplants the RMA "Type Descriptions and Packing Specifications for Natural Rubber," which with modifications from time to time have stood for 28 years as the world's most widely accepted set of standards for world trade in the 30 RMA grades which it covered. Included in the new standards are the 30 RMA grades and six new grades referred to as the Singapore types.

In the new book, 24 of the previously designated RMA types which now have the full indorsement of all of the world associations concerned, have been redesignated as "International Types." The remaining 12 types described in the new publication are the six RMA grades and six Singapore grades which now overlap to some degree. W. J. Sears, Chairman of the RMA Crude Rubber Committee, stated that all endorsing organizations have agreed to work toward the elimination of the overlapping grades with the objective of ultimately including them in Part II of the book as internationally agreed single standards.

Will Improve Quality

Mr. Sears expressed his belief that this agreement by all organizations for the first time to produce, grade, pack and ship rubber against a single set of uniform standards will do much to improve the quality of natural rubber imports into this and other consuming countries. The substandard quality of imports has plagued consumers since World War II.

The new standards were developed by the RMA Crude Rubber Committee following two international conferences on rubber quality and packing, held in Singapore and New York in 1954 and 1955. Adoption of the standards was unanimously recommended by all parties to the New York conference in 1955. This recommendation won the support of the International Rubber Study Group at its meeting in Monrovia, Liberia, later that year.

Mr. Sears noted that in 1955, only 62.6 per cent of natural rubber imports reaching the U. S. conformed to the RMA grades that were stipulated in the purchase contracts. Data for 1956 will not be available until later this year but it is indicated that there was no improvement during the past year. "Under these conditions every lot of rubber received must be carefully inspected to determine the quality level of the delivery. When the inspection discloses that the quality is below the standard for the grade purchased, claims are filed against the seller. Disputes arise that must be settled by arbitration. The problems and risks of rubber marketing are difficult enough without this added costly burden of claims, adjustments, arbitrations and recriminations between buyer and seller.

"These newly published standards", he said, "provide the tools to bring about greater improvement in the marketing of rubber. Before the adoption of these internationally agreed standards, it might have been argued that the shipper in producing countries packed to one standard and the consuming factory bought against a different standard. With the publication of this new manual, all of the organizations involved have accepted these standards so no longer will there be any justification to the argument that the delivery of substandard natural rubber has been due to misunderstanding".

Situation Before 1928

Before the so-called 30 RMA types were first promulgated in 1928, there were virtually no world standards. Trade in the rubber marts was conducted not only against widely varying sets of types established individually in such primary markets as Singapore, London, Amsterdam, Colombo, and Djakarta, but against literally hundreds of types independently established by foreign shippers and importers as well.

Introduction of RMA Type Descriptions and Packing Specifications and the RMA Type Samples did much to encourage world trade in those standards. Between 1928 and World War II, the confusing multiplicity of primary market standards and the shipper-importer types faded from the picture and most of those types disappeared. Natural rubber quality deteriorated again during the war and the troubled economic period which followed when raw material-hungry users throughout the world took rubber of any quality, RMA officials recall.

Postwar Conditions Cited

Producers complained that postwar conditions made it impossible to produce some types of rubber equal to RMA grades. These conditions gave rise to the Singapore types and a considerable amount of trade against those types which are generally regarded as being somewhat below comparable RMA types in quality.

The new standards take cognizance of the six overlapping RMA and Singapore types but do not include them within the new family of 24 international types on which there is now broad agreement. In embracing the overlapping RMA and Singapore types, however, the new standards take note of production realities of the moment.

The Joint Type Sample Committee of the RMA and the Rubber Trade Association of New York have prepared and will offer officially sealed type samples for each of the 24 grades of rubber described in the new set of international standards and for the remaining six RMA types. These master samples will be offered for sale to rubber producing, packing, shipping, trading and consuming nations throughout the world, Mr. Sears stated. The Singapore Chamber of Commerce Rubber Association will prepare and sell samples covering the six Singapore types, RMA advises.

PROMOTION OF HARRIS AND ALLEN ANNOUNCED BY NEW YORK RUBBER CORP.

Herschel G. Harris

C. Bradley Allen

New York Rubber Corp., Beacon, N. Y., has announced the election of Herschel G. Harris as president and C. Bradley Allen as executive vice-president. Mr. Harris, formerly vice-president in charge of sales for the company's Airubber Division, succeeds Mark H. Stratton who will retire this April. Mr. Stratton has been president of the company since 1932. Mr. Harris has been with the New York Rubber since January, 1937. Mr. Allen, formerly vice-president in charge of sales for the Mechanical Rubber Goods Division, has been with the firm since April, 1932. He has also been elected a director of the corporation.

AIEE RUBBER SUBCOMMITTEE PLANS TWO-DAY AKRON MEETING

The Rubber and Plastics Industries Subcommittee of the General Industry Applications Committee, American Institute of Electrical Engineers, has announced plans for a two-day conference on "Electrical Engineering Problems in the Rubber and Plastics Industries" which will be held at the Mayflower Hotel in Akron, Ohio, on April 8 and 9, 1957. This is the ninth conference on this subject. A tentative program for the conference has now been arranged. The program follows:

April 8, 1957

9:00 A.M.—Keynote address by D. Pellett (Goodrich).

9:45 A.M.—"Adjustable Speed Drives—Electrical, Hydraulic and Mechanical: Their Application to Rubber Processing Equipment" by Wilbur Jones (Goodyear).

11:00 A.M.—"Electrical Motor Braking Methods for Rubber and Plastics Industries" by John C. Ponstingl (Westinghouse).

12:00 Noon—Luncheon Recess.

2:30 P.M.—"Design Features of Electrical Installations for Areas Which are Hazardous Because of Flammable Vapors and Combustible Dusts" by C. M. Park (Mill Mutual Fire Prevention Bureau).

3:45 P.M. — "Electrical Safety Standards" by P. T. Powell (U. S. Rubber).

5:30 P.M.—Cocktail Hour.

6:30 P.M.—Banquet. Talk by M. F. Gigliotte (Monsanto) on "Plastics as an Engineering Material of Construction."

April 9, 1957

9:00 A.M.—"Aluminum Conductors" by R. R. Cope (Alcoa).

10:45 A.M. — "Programming" by L. F. Lewis (G-E).

12:00 Noon—Luncheon Recess.

2:30 P.M.—"Special Drive for Rapid and Accurate Cycling" by Tom Jones (National Rubber Machinery).

3:45 P.M.—Subcommittee Reports. "Problems Due to Atmospheric Contamination," chairman, E. L. Smith. "Standardization for Rubber and Plastics Industries," chairman, W. S. Watkins.

Symposium On Testing Scheduled

A symposium on the "Scientific Background of Testing Elastomers, Fibers and Plastomers" will be held under the sponsorship of the Division of Plastics and High Polymers of the International Union of Pure and Applied Chemistry in Paris, France on July 25 and 26. Dr. R. Houwink will preside at the meeting and Professor P. Dubois will be the secretary. The topic under discussion will be the relationship between the physical chemistry and the testing (with special reference to standardization) of elastomers, fibers and plastomers, based on their structure. Further information is available on request to the secretary, Professor P. Dubois, 292, rue St-Martin, Paris 3°, France.

Like to know what is going on in Washington? For the "inside" picture read "Capitol Cues" (page 953).

Coming Events in the Rubber Industry

Mar. 18-21. Society of the Plastics Industry, Annual National Conference, Los Angeles-Biltmore Hotel, Los Angeles, Calif.

Mar. 22. New York Rubber Group, Henry Hudson Hotel, New York, N. Y.

Mar. 28. Southern Ohio Rubber Group, Spring Technical Meeting, Engineers Club, Dayton, Ohio.

Apr. 2. Los Angeles Rubber Group, Biltmore Hotel, Los Angeles, Calif.

Apr. 5. Akron Rubber Group, Spring Meeting, Sheraton-Mayflower Hotel, Akron, Ohio.

Apr. 9. Ontario Rubber Group, C.I.C., Toronto, Ont.

Apr. 11. Fort Wayne Rubber & Plastics Group, Van Orman Hotel, Fort Wayne, Ind.

Apr. 12. Detroit Rubber & Plastics Group, Detroit-Leland Hotel, Detroit, Mich.

Apr. 12. Philadelphia Rubber Group, Poor Richard Club, Philadelphia, Penna.

Apr. 18. Quebec Rubber & Plastics Group.

Apr. 26. Chicago Rubber Group, Furniture Mart, Chicago, Ill.

May 7. Los Angeles Rubber Group, Biltmore Hotel, Los Angeles, Calif.

May 10. Ontario Rubber Group, C.I.C., Niagara Falls, Ont.

May 15-17. Division of Rubber Chemistry, A.C.S., Joint Meeting with Rubber Chemistry Division of C.I.C., Sheraton-Mount Royal Hotel, Montreal, Que., Canada.

May 24. Connecticut Rubber Group.

June 1. Southern Ohio Rubber Group, Summer Outing, Inland Activities Center, Dayton, Ohio.

June 7. Fort Wayne Rubber & Plastics Group, Summer Outing, Lake Tippecanoe, Leesburg, Ind.

June 7. Quebec Rubber & Plastics Group, Golf Tournament.

June 7-9. Los Angeles Rubber Group, Summer Outing, Sahara Hotel, Las Vegas, Nevada.

June 9-13. A.S.M.E. Semi-Annual Meeting, Sheraton-Palace San Francisco, Calif.

June 16-21. A.S.T.M., Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

June 21. Akron Rubber Group, Summer Outing, Firestone Country Club, Akron, Ohio.

June 28. Detroit Rubber & Plastics Group, Western Country Club, Detroit, Mich.

July 26. Chicago Rubber Group, Golf Outing, Medinah Country Club, Chicago, Ill.

Aug. 16. Philadelphia Rubber Group, Golf Outing.

Sept. 7. Connecticut Rubber Group.

Sept. 11-13. Division of Rubber Chemistry, A.C.S., Fall Meeting, Hotel Commodore, New York, N. Y.

Sept. 23-25. A.S.M.E., Fall Meeting, Hotel Statler, Hartford, Conn.

Sept. 26. Fort Wayne Rubber & Plastics Group, Van Orman Hotel, Fort Wayne, Ind.

Oct. 1. Los Angeles Rubber Group, Biltmore Hotel, Los Angeles, Calif.

Oct. 4. Detroit Rubber & Plastics Group, Detroit-Leland Hotel, Detroit, Mich.

Oct. 4. New York Rubber Group, Henry Hudson Hotel, New York, N. Y.

Oct. 24. Southern Ohio Rubber Group, Fall Technical Meeting, Engineers Club, Dayton, Ohio.

Oct. 25. Akron Rubber Group, Fall Meeting, Sheraton-Mayflower Hotel, Akron, Ohio.

Oct. 25. Philadelphia Rubber Group, Poor Richard Club, Philadelphia, Penna.

Nov. 5. Los Angeles Rubber Group, Biltmore Hotel, Los Angeles, Calif.

Nov. 15. Connecticut Rubber Group.

Dec. 1-6. A.S.M.E. Annual Meeting, Hotel Statler, New York, N. Y.

Dec. 5. Fort Wayne Rubber & Plastics Group, Van Orman Hotel, Fort Wayne, Ind.

Dec. 6. Detroit Rubber & Plastics Group, Xmas Party, Sheraton-Cadillac Hotel, Detroit, Mich.

Dec. 13. New York Rubber Group, Henry Hudson Hotel, New York, N. Y.

May 14-16, 1958. Division of Rubber Chemistry, A.C.S., Spring Meeting, Netherlands Plaza Hotel, Cincinnati, Ohio.

GORDON RESEARCH CONFERENCE FEATURING ELASTOMERS SESSION

The 1957 Gordon Research Conference of Elastomers will be held from July 29 to August 2 at Colby Junior College, New London, N. H. The conference was established to stimulate research in universities, research foundations and industrial laboratories. This purpose is achieved by an informal type of meeting consisting of scheduled lectures and free discussion groups. Sufficient time is available to stimulate informal discussions among the members of a conference.

Meetings are held in the morning and in the evening, Monday through Friday, with the exception of Friday evening. The afternoons are available for recreation, reading or participation in discussion groups as the individual desires. This type of meeting is a valuable means of disseminating information and ideas which otherwise would not be realized through the normal channels of publication and scientific meetings. In addition, scientists in related fields become acquainted and valuable associations are formed which result in collaboration and cooperative effort between different laboratories.

The purpose of the program is not to review the known fields of chemistry, but primarily to bring experts up to date as to the latest developments, analyze the significance of these developments, and to provoke suggestions as to underlying theories and profitable methods of approach for making new progress. In order to protect individual rights and to promote discussion, it is an established rule of each conference that all information presented is not to be used without specific authorization of the individual making the contribution, whether in formal presentation or in discussion. No publications are prepared as emanating from the conferences.

The first meeting of each conference is held Monday morning at 9:00 a. m., Eastern Daylight Saving Time. The morning sessions, through Friday, are scheduled from 9:00 a. m. to 12:00 noon. The second session of each day is held in the evening from 7:30 to 10:00 p. m., Monday through Thursday. There are no Friday evening meetings.

Individuals interested in attending the conference should request an application form from the office of the Director. Attendance at each conference is limited to 100. Requests for attendance at the conferences, or for any additional information should be addressed to W. George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, R. I. From June 10 to August 30, 1957 mail should be addressed to Colby Junior College, New London. N. H.

The following papers are scheduled for presentation at the Elastomers Conference on the dates noted:

July 29, 1957

"A Study of the Reaction of Ozone with Gr-S Rubbers" by E. R. Erickson, R. A. Berntsen and E. L. Hill.

"Effect of Gamma Radiation on Elastomers" by John Born.

July 30, 1957

"Properties of Carbon Black Recovered from Cured Rubber Stocks" by Merton Studebaker.

"Carbon Black Surface Functional Groups—Their Identification and Effects" by J. V. Hallum, K. A. Burgess and F. Lyon.

"Thermodynamics of Rubber During Reversible Extension" by P. Thirion.

July 31, 1957

"Mechanism Studies of Isoprene Polymerization with Ziegler Type Catalysts" by W. M. Saltman, W. E. Gibbs, Jogiuder Lal, and Bernard Wargotz.

"Effect of Cis-Trans Ratio on the Physical Properties of 1,4-Polybutadiene" by J. N. Short, Gerard Kraus and Vernon Thornton.

August 1, 1957

"The Dependence of Tack Strength on Molecular Properties" by L. A. McLeod and W. G. Forbes.

"Freeze Agglomeration of Latex" by Leon Talalay, Howard S. Smith, Ralph N. Kingsbury and Donald G. Dobay.

August 2, 1957

"Kinetics of Cross-linking of Tread Stocks" by John O. Cole and C. R. Parks.

"Cross-linking of Polyurethane Elastomers" by O. C. Keplinger and E. E. Gruber.

Have some comments to make? Write a letter to the editor! (See page 940).

GENERAL TIRE REALIGNS CHEMICAL DIVISION SALES DEPARTMENT

L. W. Reeves

G. Hackim

P. J. Early

Chemical Division of the General Tire & Rubber Co., Akron, Ohio, has undertaken major expansion of its Sales Department, which involves a realignment of responsibilities and the addition of personnel. L. W. Reeves has been appointed to direct rubber chemical sales; George Hackim will head the newly formed Sales Development Department while retaining his duties as manager of vinyl resin sales, and Paul J. Early will direct the newly established Technical Service Department.

Mr. Reeves, manager of chemical sales since 1954, joined the Chemical Division in 1951. Mr. Hakim, who joined General Tire in 1948, was most recently employed in a technical post in the Chemical Division. Mr. Early has been associated with General Tire since 1950, when he joined the company's Research Department. The new organization will handle sales of rubber chemicals, vinyl resins and synthetic rubber produced at the Mogadore and Ashtabula, Ohio and Odessa, Texas plants, respectively.

Also appointed during the reorganization of the Sales Department was James Hostettler, as senior sales representative for synthetic rubber with headquarters in Akron. To be headquartered at sales offices for synthetic rubber maintained in Akron, Boston, New York and Chicago are the following field representatives: Victor E. Buehrle (Akron-West); Edmond B. Deckel (Akron-East); Vincent T. Cox and Richard B. Daley (Boston); Edward McBride (New York) and Philip Mackler (Chicago). Norman Phillips has been appointed sales development engineer to assist Mr. Hakim.

Hewitt Air Drill Hose

Hewitt-Robins Inc., Stamford, Conn., has developed a new hose for pneumatic drills which finds heavy-duty use in quarries, mines, road construction and other types of service requiring a hose that is tough, yet light and flexible and easy to handle. Named the "Duroil Air Drill Hose" the hose contains a nitrile tube, that resists oil and oil vapors; a braided rayon cord carcass which will not contract, elongate or fight back under working pressures, and a cover of natural rubber having a tensile strength in excess of 2,000 pounds per square inch. According to the company, the hose is capable of resisting tearing, gouging and impact abuses common to air drill hose service. The product is available in 500 foot reels and diameters of ½, ¾ and 1-inch.

Converts To Cold Rubber

Goodrich-Gulf Chemicals Inc., has disclosed plans to convert a production line in the Institute, West Va. synthetic rubber plant to the manufacture of cold rubber. During the changeover, production capacity of the unit will be doubled to 50,000 tons a year. The conversion will cost more than $2,000,000 and is scheduled for completion early in 1958. This is another step in the company's modernization program for the Institute plant, which was purchased from the government for $11 million in February, 1956.

ASTM COMMITTEE D-11 HOLDS SPRING MEETING IN PHILADELPHIA

Committee D-11 on Rubber and Rubberlike Materials of the American Society for Testing Materials held its Spring Meeting on February 6, 7 and 8 at the Benjamin Franklin Hotel in Philadelphia, Penna. Subcommittee meetings were held both in the morning and afternoon on February 6 and 7, and in the morning of February 8. The subcommittee meetings were followed by a meeting of the full committee, also held on the morning of February 8.

It was announced at the meeting that R. Anderson (Goodrich) had accepted the chairmanship of Subcommittee 16 on Packings succeeding Fred Thorn, who has retired. Howard Tangenberg has succeeded Dr. B. S. Garvey, Jr. (Sharples) on ISO/TC-45 Working Group 13 on Flex Cracking, and on the American Group for ISO/TC-45. Mr. Tangenberg is also chairman of Subcommittee 18 on Flex Cracking and Cut Growth.

C. W. Pickels (Consolidated Edison), chairman of Subcommittee 9 on Insulating Tapes, has been appointed to represent Committee D-11 on ASA Sectional Committee C-59 on Electrical Insulating Materials. R. S. Schatzel (Rome Cable) has agreed to represent D-11 on ASA Sectional Committee C-8 on Insulated Wire and Cable (other than telephone and telegraph).

Joseph Breckley (Titanium Pigment) has accepted appointment as D-11 representative to Subcommittee 2 of Committee E-1 on Sub-Sieve Testing. John Ingmanson has accepted appointment as research coordinator for Committee D-11 to tie in with the ASTM committee headed by Dr. McPherson (NBS). R. G. Seaman *(Rubber World)*, has been named chairman of Subcommittee 8 on Nomenclature, succeeding Harry Fisher.

New Committee Formed

The formation of a new ASTM committee was also announced at the meeting. This new committee, the Coordinating Committee on Cellular Materials, will be headed by F. W. Speight of ASTM headquarters and will include representatives from ASTM Committees D-9, D-10, D-11, D-20, ASTM-SAE Tech A, S.P.I. and S.P.E. As the name implies, the new committee will attempt to coordinate divergent activities on cellular materials now handled by each of the individual groups.

A special task group under L. V. Cooper (Firestone) with members to be appointed by D-11 Chairman S. Collier (Johns-Manville) will be charged with the responsibility of defining "rubberlike materials." H. Bimmerman (DuPont) has been named as representative to Committee E-10 on Radioisotopes and Radiation Effects.

It was also announced at the meeting that ASTM is contemplating changing the manner in which it presently publishes its specifications. Copies of the proposed changes have already been put in the hands of the subcommittee chairmen. It was urged that all members who have suggestions on this subject, forward them to P. J. Smith at ASTM headquarters. D-11 has also been asked by the parent society to furnish some indication of the rate of growth of the specifications established by the committee so that plans may be made for the 1958 Book of Standards.

As to forthcoming meetings, it was announced that the Annual Meeting of the Society will be held on June 17, 18 and 19 at Atlantic City, N. J.

Some details for the forthcoming International Meeting which will be held on November 8 to 13, 1959, in Washington, D.C., were also announced. Committees from each of the three major participating societies have already been named as shown in the box which appears elsewhere on this page. Efforts are being made to coordinate the International Meeting with the meeting of ISO/TC-45 which is being held at about the same time in New York City.

It should also be reported that at the Advisory Committee meeting which took place on the evening of February 7, a message was read from Arthur W. Carpenter, retired secretary, in which thanks were extended to the committee for the gift which it had presented to him on the occasion of his retirement.

In the absence of Mr. Collier, Harry Bimmerman (DuPont), vice-chairman of D-11, served as chairman of the full committee meeting on February 8.

There follow herewith reports from the chairmen of the various subcommittees which met during the D-11 meeting in Philadelphia.

Subcommittee 1—Hose (R. A. Bonnell, Goodyear, Chairman): This subcommittee did not hold a meeting. It is, however, referring to D-11 and recommending for letter ballot a specification covering "Proposed Tentative Methods of Testing Rubber Hose" and is recommending that this specification, which contains numerous additions to and revisions of the present similar specification, be made to supercede the Tentative Standard designated as D-380-51T.

Subcommittee 5—Wire and Cable (J. T. Blake, Simplex Wire & Cable, Chairman): Reports were presented on progress toward writing specifications for synthetic braids and the newer types of polyethylenes. Several changes in present specifications were voted which will be letter balloted. A portion of the meeting was devoted to a discussion of work aimed at putting dimensional requirements of specifications on a statistical rather than an absolute basis. Enough interest was shown so that probably more time will be devoted to this subject at future meetings.

Subcommittee 6 — Packings (R. F. Anderson, Chairman): Tentative Standard D-1081-49T "Evaluating Pressure Sealing Properties of Rubber and Rubberlike Materials" was reviewed. This standard is used by the Navy as Federal Standard 601, Method 3211; it was reported that some work is under way on another fixture. It was recommended, therefore, that this standard remain as a tentative. The negative ballots cast on the D-733 letter ballot were resolved by correspondence within the committee prior to this meeting. Galley proofs of the corrected method have been received.

H. C. Koch of Johns-Manville Co. reported on the round-robin stress-relaxation program under way in Subcommittee 10c of Tech. A. R. W. Lampertz of Carter Carburetor Corp. summarized the sealibility program initiated in Subcommittee 10c of Tech. A and described the test fixture developed. The need for a corrosion test procedure in D-733 was discussed. A test method used by Wright Aeronautical Division was submitted and will be circulated to the subcommittee members with minutes of this meeting for study.

Subcommittee 9—Insulating Tapes (C. W. Pickells, Consolidated Edison, Chairman): Revisions of D-69-52T, "Specifications for Friction Tape for General Use for Electrical Purposes"; D-119-48T, "Specifications for Rubber Insulating Tape"; and D-1373-55T, "Specifications for Ozone Resistant Rubber Tape" were recommended by Subcommittee 9 for letter ballot in Committee D-11. The subcommittee discussed the need for a moisture resistance requirement in the two rubber tape specifications and agreed that some such requirement should be added. A task group will be appointed to recommend test methods and acceptable limits.

Subcommittee 10—Physical Testing of Rubber Products (L. V. Cooper, Firestone, Chairman): The task group on O-ring clamps under R. F. Turner, reported as follows on the questionnaire they sent out: Answers, 240; Number using single roller clamps, 34; Number using double roller clamps, 4; Number using split roller clamps, 3, and the number using hook roller clamps, 4. Speed of testing varied from 12 to 24 inches per minute. Of 34 using single roller clamps, 22 power rotated the lower grip roller. On vote of the subcommittee, Mr. Turner and Mr. Juve were asked to compare single and double clamps. Single roller clamps to be loaned by Scott Testers, Inc., and the

International Conference Committee

Representing ACS:
- A. E. Juve* (Goodrich)
- B. S. Garvey, Jr. (Sharples)
- A. W. Sloan (Atlantic Research)

Representing ASME:
- R. D. Stiehler (NBS)
- G. L. Bruggemeier (Firestone)
- R. W. Seaman (Rubber World)

Representing ASTM:
- S. Collier (Johns-Manville)
- J. Allen (Firestone)
- H. Bimmerman (DuPont)

* Over-all chairman.

double roller loaned by the Bureau of Standards.

As an interim guide, the subcommittee agreed to the insertion of a footnote at the bottom of page 213 under D-412-51T as follows: "Extensive investigation in January, 1957, revealed that most users of ring test specimens were testing with a single spool on each clamp with the lower spool being power rotated."

The chairman asked if there was a need for a study of equivalent cure between slabs for tensile test and slabs for compression set determinations or other products of irregular contour. The subcommittee voiced considerable interest and authorized the appointment of a task group to study this problem. The chair immediately asked Messrs. Juve, Svetlik and Conant to serve on this group. The chairman of the task group on tensile machine calibration promised a report at the June meeting.

Subcommittee 11—Chemical Analyses (W. P. Tyler, Goodrich, Chairman): The subcommittee has been requested to sponsor Specification Test Methods for rubber chemicals, at present limited to accelerators and antioxidants. A task group under G. C. Maassen has been set up to study and present the methods. One of the test methods desired by Subcommittee 13, the determination of mixed alkylated phenols in SBR rubbers, has given trouble in practice. B. C. Pryor has been requested to form a task group, under the jurisdiction of either Subcommittee 11 or 13, to study this method.

A report on determination of carbon black in rubber by the pyrolysis method, indicates progress, but insufficient test data are available as yet. Test programs have been organized for a proposed rapid determination of zinc in rubber compounds and for rapid extract methods. A request for a method for determination of soluble sulfates and chlorides in insulating rubber sheet, will be taken under advisement when a suitable task group can be organized.

Subcommittee 12 — Crude Natural Rubber (Norman Bekkedahl, National Bureau of Standards, Chairman): It was recommended that Method D-1278-53T, "Test for Harmful Dirt in Crude Natural Rubber" be continued as a tentative method for at least another year. The ISO is at present working on this procedure, and it may be that it will be modified as a result of discussions with the ISO committee.

Subcommittee 13—Synthetic Elastomers (B. S. Garvey, Jr., Sharples Chemicals, Chairman): The subcommittee voted to ask D-11 to submit to letter ballot the proposed method of sampling as proposed and letter balloted in the task group under Larry Mason. The proposal includes the modifications as suggested in replies to the group letter ballot. B. C. Pryor stated that in spite of the fact that D-1416-56T was already published, his group was continuing on (a) ETA extract, (b) estimation of oil content, (c) estimation of antioxidant content in oil-extended polymers, and (d) determination of mixed alkylated phenol type antioxidant. In regard to physical testing, the members of Subcommittee 13 were informed that this work was being done in Subcommittee 29 and any members wanting to be on this committee should inform the D-11 secretary.

Mr. Patterson recommended and the subcommittee approved the authorization of a letter ballot in D-11 the substitution of (Note) "An alternate method for determination of total solids in synthetic rubber latex is described in D-1076-54T for Natural Rubber latex" for the note on page 190 in D-1417-56T. Mr. Patterson also stated that more cross checking was being done to make sure the method was the best possible.

The Nomenclature Committee brought up the question of a family letter designation for silicone rubbers and the subcommittee was asked for further investigation and a report at the June meeting. The subcommittee also recommended that in all ASTM publications, that the new nomenclature be used, especially using SBR for GR-S. The subcommittee secretary was also instructed to ask all government committees to cooperate in the use of the new nomenclature. The task group on Standard Methods was discharged with thanks inasmuch as the standard SBR bale has been secured. The task group on Code Numbers was also discharged with thanks as their assignment had been completed.

Considerable discussion resulted on the report of the subcommittee chairman as to his recommendation on how new numbers will be assigned to new production types of rubber and just how this assignment should be publicized. His plan was accepted with certain modifications, and will be circulated in Subcommittee 13 for letter ballot.

Mutual Fund Ownership

Tire and rubber company stocks occupy a prominent position in the broadly diversified portfolio of the Wellington Fund. This $580,000,000 conservatively-managed mutual fund at the close of 1956 had equity investments in this industry in excess of $18,300,000, based on market prices at the year end. Four of the nation's leading tire and rubber companies were represented in the Wellington Fund portfolio on December 31, 1956. These holdings consisted of 54,000 Firestone Tire & Rubber; 53,100 B. F. Goodrich; 82,620 Goodyear Tire & Rubber and 48,348 U. S. Rubber. The significance of this investment is that more than 200,000 individual, institutional and fiduciary shareholders of Wellington Fund now indirectly have a $18,300,000 investment in these leading tire and rubber companies.

Subcommittee 15—Life Tests for Rubber Products (G. C. Maassen, R. T. Vanderbilt, Chairman): It was voted to recommend that D-865-54T be advanced to standard; one change in paragraph 8(a) is involved, which will delete the 250-300° F. temperature range and substitute a reference to D-1349 for recommended temperatures. A motion was carried to retain D-1206-52T as tentative because of insufficient experience with the test. It was voted to recommend a tentative revision for D-518-54, which will add Method C for a tapered specimen. The proposed method has circulated through Subcommittee 15 and now requires but two minor changes. No new information was available on a revised method for calibrating the light source under D-749-43T, but the work is going on now in Committee E-1, and more data are expected in the near future.

A motion to sponsor a symposium covering ozone and rubber for the June, 1957, ASTM meeting, was defeated. It was then voted to authorize the designated task group to investigate and select the timing of such a symposium and to review the papers. Mr. Milnes of Mast Development Corp., was appointed chairman of a task group to study dynamic flexing methods for use in ozone testing. Messrs. Juve, Carlson and Shaw were appointed to this group. Mr. Milnes agreed to speak before Committee D-11 at the June, 1957, meeting to summarize the types of dynamic ozone methods which are now in use throughout the rubber industry.

Subcommittee 17—Tests of Hardness, Set and Creep (S. R. Doner, Raybestos-Manhattan, Chairman): The chairman read the comments he had sent to R. E. Hess of ASTM regarding the "Draft British Standard, Methods for the Determination of Compression Set" "CW (RUC) 9215." The "Micro - Hardness Tester" was again discussed by the chairman, also the Mare Island Navy Yard report by R. E. Morris and J. M. Holloway on the micro-hardness instrument developed by Dr. Oberto of Italy. A limited amount of interest was shown by those present, the project was tabled and will be brought up again in the future. The matter of advancing ASTM D-314-52T to standard was discussed. Some members were in favor of deleting it from the Handbook. A subcommittee ballot will be circulated.

It was noted that ASTM Method D-676-55T on Durometer Hardness does not contain a paragraph on "Report." But the report instructions are contained in the method. The chairman was instructed to discuss this matter with Paul Smith and be guided by his decision, as to whether a Report paragraph should be added.

Some discussion relative to checking the A-2 Shore Durometer for conformance to ASTM D-676 took place. The concensus of opinion was that it is the manufacturers' responsibility of any test instrument to make it conform to the requirements of any accepted test method. No work is contemplated.

Mr. Frye reported that the statistical

committee of D-11 was not able to complete their analysis of his work. Mr. Frye was asked to submit a copy of his report to each person present and thus terminate his present assignment.

Subcommittee 20 — Adhesion Tests (H. H. Irvin, Marbon Corp., Chairman): Although D-429, Sections A and B, on adhesion testing have been but recently revised, it is no secret that this test even now does not represent all that it is desirable to have. This is particularly true in cases where an all rubber break, or a stock failure is present. Then it can be reported that the adhesion is of a higher nature than the recorded pull. At the moment, the subcommittee is trying to keep abreast of developments which might improve this situation. Present efforts involve areas of non-destructive testing using ultrasonic means of detecting band quality, fatigue testing under dynamic conditions and either modifying or supplementing the present D-429, especially Method B by introducing the aspect of elevated temperatures.

Reports given indicated the current status of these investigations. H. Macy of Goodrich reported that current non-destructive techniques using ultrasonic methods have only advanced to the point of indicating band or no band but not the degree of quality of any band. B. Frye of Inland reported no advances in dynamic fatigue testing methods and not too much interest. The feeling appears to be that static methods are doing the job and dynamic fatigue tests offer no improvements.

P. P. Larson of Lord introduced the possibility of modifying or supplementing the current D-429 method especially Section B by introducing the aspect of elevated temperatures as a condition of the test. It was pointed out that a test could be set up wherein we might control such things as time, temperature and stress, keeping any two of these constant while varying the other. This idea was to be summarized so that committee members might determine if any interesting potential exists and discussed further at the next meeting.

H. H. Irvin, Marbon Division of the Borg-Warner Corp., reported that no word had been received from ISO/TC-45 on our latest comments to them regarding D-429 revisions. It was the feeling of the group that a recommendation was in order to suggest that Subcommittee 20 be represented in E-7 to keep D-11 at large, and Subcommittee 20, specifically, abreast of developments in the area of non-destructive testing.

Subcommittee 21—Cements and Related Products (J. F. Anderson, B. F. Goodrich, Chairman): It was decided by formal action of those present to request that D-1084-55T Methods of Test for Consistency (under jurisdiction of D-14), be printed in the D-11 Manual. This action, if approved by D-11 and ASTM headquarters, will provide needed alternate methods for determining viscosity. Present D-553-42 Methods have been considered inadequate. An alternate method of determining total solids is needed. A member offered to submit a procedure for rapid test for total solids.

It was agreeable to the committee that cooperation between the chairmen of Subcommittee 21 of D-11 and Subcommittee 8 of SAE by correspondence and interchange of information be carried out in order to avoid duplication of effort. This should be mutually beneficial.

No changes in D-1205-53T were proposed, although a bend test method was submitted for discussion. This method will be circulated to the subcommittee for comments and approval. A discussion of the Chrysler block shear test, for friction materials bonded to metal, led to the conclusion that this proposed method will be included in D-1205-53T when satisfactorily formulated. This is a matter of cooperation between Subcommittee 21 and SAE.

A formal request for clarification of D-903-49 was received from Samuel B. Steinberg of the Army Chemical Center. This method is under the jurisdiction of D-14. The letter will be referred to that committee for answer. Acceptance of this report implies approval of D-11 to add D-1084-55T as alternate methods for testing consistency or viscosity of rubber cements and related products.

Subcommittee 23—Hard Rubber (W. J. Dermody, Stokes Molded Products, Chairman): This subcommittee has passed without negative vote, a proposed revision of the Hot-Cold cycle test and recommends to D-11 that it be adopted by the committee as a revision of Tentative D-639-52T. A proposed revision of the following weight impact test in D-530 was defeated on letter ballot: 8 affirmative, 7 negative, 1 not voting out of a total of 16 ballots returned. The proposal was referred back to the task force for further consideration in the light of the comments made in the letter ballots and at the meeting. A method for tensile impact presented at a previous meeting of D-20 was again presented for consideration.

A proposed tentative method of test for indentation hardness of hard rubber by means of a type D Durometer prepared by K. Bushway was discussed and approved with minor revisions. This method is recommended to Committee D-11 for letter ballot on acceptance as tentative.

The chairman reported on membership contacts and three new members were welcomed to the subcommittee.

The desirability of a specification classifying available hard rubber materials was discussed and a task force under the chairmanship of H. Peters was appointed to investigate available information and the possibilities for classification of materials. Consideration was given to revisions of D-530-55T to standardize with D-20 on methods of test for tensile strength, flexured strength, Rockwell hardness and Durometer D hardness. Mr. Wentland was appointed liaison to D-20 for this purpose.

D. E. Jones requested consideration of a preferred method for the determination of water absorption of hard rubber to be included in D-530 and was requested to collect comments on his suggestion and submit a recommendation at the June meeting.

Two revisions of D-530 to include the standard temperatures in D-1349 as part of D-530 and to replace the present softening point determination by substituting heat distortion in accordance with D-648 as part of D-530 have been previously approved by subcommittee and are recommended to D-11 for letter ballot on revision of tentative.

Subcommittee 24—Tests for Coated Fabrics (K. L. Keene, U. S. Rubber, Chairman): It was voted to change the scope of the subcommittee to read Rubber and Rubberlike Coated Fabrics. This is considered an editorial change. It was also voted to retain D-751-57T as a tentative standard pending completion of intralaboratory tests now in progress. It was voted to submit the recommendations of the task group on diaphragm burst to subcommittee by letter ballot. Plans were formulated for inter-laboratory tests on adhesion, cold flexibility and tack tear tests. Reports were made on dead weight, DuPont scrub tester, Gelbo tester and sand blast abrasion tests. Various items of new business were submitted and these will be sent to all members of the subcommittee to ascertain their interest.

Subcommittee 25—Low Temperature Tests (R. S. Havenhill, St. Joseph Lead, Chairman): W. D. Brown of the Chrysler Corp., gave an interesting talk describing their novel strain gage oscilloscope method of determining the impact speed of the Scott Solenoid Tester. It was shown that with a supply voltage of 94 volts A. C. their instrument would meet the D-746-55T velocity specification of 6.5 ft. per second. Copies of this paper were passed out at the meeting.

R. E. Ofner of the Rock Island Arsenal passed out copies of their report No. 57-100 which showed that the MLI,

Italian Billboards To Go

The Italian Association of Automobile and Related Industries (ANFIAA) has announced an agreement reached by the automobile and tire manufacturers to eliminate highway publicity on the entire Italian highway network as of December 31, 1956. It is expected that this move may bring about the end of billboard advertising in Italy, as increased pressure and criticism of remaining billboards will compel other advertisers to follow suit.

BS903 and BS903 hardness instrument with double the major and minor loads, showed no significant reproducibility differences for 9 different stocks run at temperatures of +73°F —40°F., and —65°F. These data indicated the value of higher loads for determining the hardness of extremely hard stocks at very low temperatures. A committee was appointed by the chairman to study the effect of a built-in foot, or no foot. If the differences in results due to variations in the size of specimens can be resolved, the same hardness instrument can possibly be used in the ISO method for both room and low temperature tests. The committee includes I. Kahn, chairman; C. K. Chatter and R. E. Ofner.

Due to inaccuracies in this method and also possible future changes in the temperature of test it was recommended by the committee that this method be retained as tentative.

A motion was made, seconded, and unanimously carried that the chairman appoint a committee to go over Method D-1053-54T Stiffness and make modifications to take care of possible jaw freezing, test chamber temperature variations and other changes to make the method more workable. Those appointed were: R. E. Ofner, chairman; R. Shearer, F. S. Conant and N. R. Miller.

A motion was made by J. F. Svetlik that two sentences be added to method D-1329-54T (TR test), regarding the use of 50% elongation in reference to crystallization and correlation of results with stiffness tests. This motion was carried and the revision will be letter balloted in Subcommittee 25. A motion was made, seconded, and unanimously carried that method D-1349-54T (Standard Test Temperature), be retained as a tentative standard as additional temperatures may be added in the future.

Subcommittee 26—Processibility Tests (R. H. Taylor, Vulcan Detinning, Chairman): A report was given by T. Wolczynski, chairman of the task group appointed to investigate the possibility of finding a more stable rotor for use in the Mooney viscometer. On the basis of simple viscosity tests, the task group recommended acceptance of the special 48 grooved rotor investigated. The subcommittee, however, felt that more work should be done particularly in the field of synthetic rubbers and for determination of cure charactertistics. The subcommittee also recommended the thickness of the special rotor be reduced slightly to bring the viscosity readings more in line with those obtained with the standard rotor. The task group was so instructed.

The subcommittee authorized the chairman to recommend to D-11 that the following proposed additions and changes to ASTM Method D-927 Table I, be submitted to letter ballot of D-11: (1) Under Method of Preparation Table I add the following at the end of the first paragraph: "Measure the viscosity of standard rubber compounds, prepared in accordance with ASTM Method D-15 between 2 and 4 hours after mixing." (2) In the second paragraph, substitute "122 ±9°F.," for 'between 110 and 130 °F.," and (3) For the last two sentences, substitute "Prepare two specimens 1¼ inches in diameter from the thickest portion of the sheated sample. Allow the massed rubber to rest at room temperature for at least 30 minutes before measuring its viscosity."

Subcommittee 29—Compounding Ingredients (A. E. Juve, B. F. Goodrich, Chairman): The results of a letter ballot in the subcommittee on a proposed revision of D-15 to incorporate formulation and mixing procedures for synthetic rubbers and other modifications were discussed. There were 34 affirmative votes and 4 negative votes and 2 not voting. The negative votes were discussed at length. There were ten principal points in the negative votes only two of which were controversial. These were the formula for testing SBR 1502 and the proposed method of conditioning the carbon black. It was finally decided that the footnote to Table II should be revised and that a committee consisting of Messrs. Patterson, Svetlik and Stiehler will consider an acceptable wording. With this change and some minor editorial changes, the proposed revision is to be submitted to D-11 for letter ballot.

It was announced that the National Bureau of Standards is now actually planning to seek bids immediately for the preparation of a standard lot of natural rubber.

The task group designated to study the desirability of refining carbon black stocks following mixing reported that the data which they collected did not support the proposal that refining is necessary. A rough draft of a proposed method for evaluating carbon blacks was discussed to reconcile conflicting views on various points. The question of incorporating the carbon black procedures in D-15 or preparing a separate method was discussed. It was agreed that the chairman would rewrite the proposed method including the modification agreed upon at the meeting and a copy of this would be forwarded to Dr. Stiehler so that he could attempt to incorporate it in a trial draft of a combined method. The membership would then consider the two versions.

OAK RUBBER PURCHASES LARGE FACTORY BUILDING IN EXPANSION MOVE

Oak Rubber Co., Ravenna, Ohio, in accordance with its current expansion program has purchased a factory building in Ravenna from the Cleveland Worsted Mills. The building is a large brick structure with four floors and 125,000 square feet of floor space. It is located on a 4-acre site on which there are also several smaller buildings. Situated on the main lines of both the Pennsylvania and Baltimore & Ohio Railroads, the plant also offers truck docks and ample parking facilities. The new facilities will enable Oak Rubber to expand its balloon and toy lines and to further diversify into the plastics field.

CSC-Thermatomic Merger Proposed

The boards of directors of the Commercial Solvents Corp. and the Thermatomic Carbon Co. voted on February 13 to recommend to their respective stockholders the merger of the two companies. Under the proposal, Commercial Solvents would be the continuing corporation and stockholders of Thermatomic would receive 18 shares of CSC stock for each share of Thermatomic stock. CSC now owns 68.7 per cent of the outstanding shares of Thermatomic. Commercial Solvents stockholders will act on the merger proposal at their annual meeting on April 4. Thermatomic stockholders will act on the merger proposal on April 2. Information regarding the proposed merger will be included in proxy statements which are being prepared for distribution to the stockholders.

Denies Patent Infringement

U. S. Rubber Co., New York, N. Y., has termed "without merit" the patent infringement suit involving three-dimensional fabrics brought against it by the Bates Manufacturing Co. "U. S. Rubber firmly believes that its patent is completely valid and is fully confident that its position will be upheld," William E. Clark, vice-president and general manager of the Textile Division, said. "The rubber company will continue to supply three-dimensional fabric under its trade name "Trilok" to automotive and furniture manufacturers as well as other industrial consumers. We will stand back of all sales of our product and will protect fully our customers' interests. We will also continue to expand our multi-million dollar program for the production, sales and advertising of Trilok," Mr. Clark said. Collins and Aikman Corp. has been licensed under U. S. Rubber patents, Mr. Clark pointed out, and will continue to supply fabric of the Trilok type to their customers. U. S. Rubber, he said, is also giving consideration to the licensing of other manufacturers under its patents. The rubber company has been engaged in the research and development of three-dimensional fabrics since shortly after World War II. It applied for a patent on September 8, 1948. This patent was issued on August 19, 1952 and reissued on May 24, 1955. The Bates suit was filed on Wednesday, February 20, 1957 in the United States Court for the Southern District of New York in Manhattan.

Alco Oil Research Appointments

Alco Oil & Chemical Corp., Philadelphia, Penna., has announced the appointment of Robert A. Martin and Daniel L. Worth to the company's research staff. Mr. Martin, formerly research associate at Squibb Institute for Medical Research, New Brunswick, N. J., joins Alco Oil as a group leader in chemical research in the field of acrylic latices. Mr. Martin attended Rutgers University as an undergraduate and received his M. A. and Ph. D. in organic chemistry from Princeton University. He is a member of the American Chemical Society, Phi Beta Kappa, Sigma Xi and Phi Lambda Upsilon. Mr. Worth will handle research on problems of warp sizing. Previously a textile chemist for the Chemstrand Corp., Decatur, Ala., Mr. Worth is a graduate of Georgia Tech with a degree in chemical engineering. He is a member of the American Association Textile Chemists and Colorists.

Bell Buys Lake Erie Engineering

Bell Aircraft Corp., Buffalo, N. Y., has purchased Lake Erie Engineering Corp., also located in Buffalo, which will become a wholly-owned subsidiary with no changes in management or personnel planned. The price paid for the privately-owned company was not disclosed, but it is reported that financial sources estimated the purchase price at more than $5 million. It is understood that Bell is giving cash and a substantial amount of Bell stock to acquire Lake Erie Engineering, its sixth subsidiary.

Receives Editorial Post

Dr. S. D. Gehman

The Division of Rubber Chemistry of the American Chemical Society has announced the appointment of Dr. S. G. Gehman as an associate editor of *Rubber Chemistry and Technology*. In this capacity, Dr. Gehman will assist C. C. Davis, editor of the journal. Dr. Gehman, head of the Physics Section of the Research and Development Division, Goodyear Tire & Rubber Co., Akron, Ohio, has been associated with Goodyear for twenty-eight years. Born in Altoona, Penna., Dr. Gehman attended the University of Pennsylvania where he received his A. B., M. A., and Ph. D., degrees. He joined the Goodyear organization on January 1, 1929. Dr. Gehman has been active in various radiation programs and currently heads up Goodyear's activity in this field which involves the use of Cobalt 60 in a new, specially designed and equipped radiation laboratory. He is a member of the American Chemical Society and the American Physical Society.

Named Head of Woonsocket Rubber

Woonsocket Rubber and Plastics Products Co., Woonsocket, R.I., has announced the appointment of Bertrand C. Miclette as president and general manager, succeeding George R. Keltie, who has retired from active management of the organization. Since his appointment, Mr. Miclette has selected a new management staff. Michael Storti has been appointed general sales manager; Robert J. Reilly, production manager; John C. Harvey, sales manager for rubber thread; and James Barry, cost accountant. Robert C. Ferris remains as plant superintendent and A. J. Gobeille as assistant treasurer. Except for the appointment of Mr. Reilly to succeed Mr. Miclette as production manager, there have been no changes in production supervisory personnel. Mr. Keltie, who retired in October, still retains his membership on the board of directors.

Goodyear Pension Plan Suit

According to current reports, Metropolitan Life Insurance Co. has asked in a suit in Federal district court in Cleveland, Ohio, to be relieved of participation in a pension plan involving the Goodyear Tire & Rubber Co. The pensions are administered by Wingfoot Corp., a Goodyear subsidiary set up for that purpose. Under an agreement made in 1928, Metropolitan said, Wingfoot has purchased from it 13,184 annuities totaling nearly $25.3 million through 1956. According to Metropolitan's petition, Wingfoot has canceled 4,000 of the annuities before they matured and has allowed only 13 to mature—none since 1950. Nearly 50 per cent of the cancellations came within five years of the maturity date and nearly 40 per cent within one year prior, the petition continued. That procedure, Metropolitan said, "converted the transaction between the parties from one involving annuities into one involving a deposit account as a form of banking"—a type of business the company is not licensed to engage in, the insurance firm stated. Metropolitan offered to return to Wingfoot funds it now holds if it is released from the agreement. Goodyear said it would answer the suit "in due course". Meanwhile, Goodyear said, the dispute will not affect payment of pensions as they fall due, since the Metropolitan contract "is only one of several media through which the company has made provision for funds to pay pension benefits".

Carbide And Carbon Promotes Two

Carbide and Carbon Chemicals Co., New York, N. Y., has announced the appointment of D. S. Alcorn as assistant manager and Dr. T. J. Hall as product manager of the Fine Chemicals Department. Mr. Alcorn joined the company in 1943, when he was graduated from the University of Pennsylvania with a B. S. degree in chemical engineering. He has been associated with the firm's marketing and product development activities continuously except for a period from 1944 to 1946, when he served in the U. S. Navy. Dr. Hall has been with Carbide and Carbon since 1953, after he received his Ph. D. at the University of Rochester. His undergraduate work was done at Carnegie Institute of Technology. He was a Fellow of Mellon Institute of Industrial Research at Pittsburgh, Penna. At Carbide and Carbon, Dr. Hall's responsibilities have included the development of markets for chemical intermediates.

Wszolek Joins Lea Fabrics

Stanley J. Wszolek, formerly associated with the Rubber Corp. of America, has joined Lea Fabrics, Inc., Newark, N. J., where he will serve as assistant to M. R. Buffington, chief chemist, in the development of foam sponge products. While with the Rubber Corp. of America, Mr. Wszolek was engaged in the development of latex compounds. He was graduated from New York University in 1941 with an A.B. degree in chemistry, and served with the U. S. Army Medical Corps during World War II.

Appointed Research Director

Wayne F. Nelson

A. Schulman, Inc., New York, N. Y., has appointed Wayne F. Nelson director of research and development. In his new capacity, Mr. Nelson will work on the development of new and improved synthetic rubber and plastic compounds to meet customer specifications. He will also be in charge of quality control for the Schulman operation. Mr. Nelson, a graduate of Augustan College in Rock Island, Ill., with a degree in chemistry, has specialized in management training, quality control and related fields. Prior to joining Schulman he was assistant plant manager and later plant manager and director of research for the American Container Corp., a division of Gould National Batteries. Mr. Nelson is a member of the American Chemical Society, Division of Rubber Chemistry and of the American Society for Testing Materials.

Tall Oil Unit On Stream

Hercules Powder Co., Wilmington, Del., has announced the beginning of operations at the company's tall oil fractionation plant in Savannah, Ga. Initial operations began at the first of the year and the plant is now operating at rated capacity. The plant, which manufactures resins, purified fatty acids and related products from crude tall oil, is operated in conjunction with Hercules Paper Makers Chemical Department. The facility processes tall oil obtained under long-term agreements from a group of southern kraft paper mills. The Savannah tall oil plant is the second such operation to be built by Hercules in the past two years. The first tall oil plant, at Franklin, Va., began operations last year.

Crown Cork Elects New Officers

The board of directors of the Crown Cork & Seal Co., Inc., Baltimore, Md., has elected John F. Connelly chairman of the board succeeding John J. Nagle. Mr. Connelly is also a member of the board of directors and a chairman of the Executive Committee. Mr. Nagle, a director of the company, was elected chairman of the newly formed Finance Committee.

LABOR NOTES

Agreement of a new master contract between the Goodyear Tire & Rubber Co. and the United Rubber Workers, covering some 24,000 hourly employees in 11 Goodyear plants, was reached on February 10, shortly before the expiration date of the old contract. The contract provides for a number of improvements in general working condition provisions for approximately 14,000 hourly employees in Akron and 10,000 in other cities. General wage levels were not a subject of the negotiations. Highlights of the new agreement include a more liberal vacation program; standardized paid lunch periods; increased payments for night bonus, and makeup pay for employees who are required to enter upon active training duty as reservists.

Additional negotiations are now going on between the O'Sullivan Rubber Corp. and Local 511 of the URW in an attempt to settle a strike which has been in progress since May 12, 1956. During this period, the company has continued in production, hiring employees to replace the strikers. The union insists that those on strike be returned to their jobs with unimpaired seniority in the event a settlement is reached. The company has said it will not yield on the matter of protecting the job security of employees hired since the walkout. The union's original request for a pay increase of 15c an hour and other benefits has reportedly been lowered to 7c an hour.

In a recent election supervised by the National Labor Relations Board, employees at the West Helena, Ark., plant of the Mohawk Rubber Co., voted in favor of organizing a union. Neither company or union officials have commented upon the election or as to what effect it will have on operations of the plant.

Borden Opens Formaldehyde Plant

Chemical Division of the Borden Co., New York, N. Y., has formally opened a new formaldehyde plant at Kent, Wash., with an annual production capacity of 36 million pounds. The new plant is said to make Borden the largest formaldehyde producer on the West Coast. The Kent facility will be the first to use the Karl Fischer process, for which U. S. rights were leased last year by Borden from Apparate und Rohrleitungsbau in West Germany. The process is said to permit a higher yield in formaldehyde production and lower utility and steam requirements for processing. According to the company, a 93 per cent yield is anticipated, compared with the national average of 82 to 88 per cent. The Kent opening raises Borden's West Coast chemical operations to five and brings its foreign and domestic chemical plant total to 25. The Chemical Division has an extensive Centennial year expansion program underway. Other plant openings are scheduled to take place in 1957.

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Named Dayton Vice-President

Harry S. Mooradian

Harry S. Mooradian has been named vice-president in charge of manufacturing for the Dayton Rubber Co., Dayton, Ohio. In his new capacity, Mr. Mooradian will be responsible for all production operations and related activities, including Dayton Rubber's plant modernization and expansion programs. Mr. Mooradian, the company's longest service employee, joined Dayton Rubber 44 years ago as a tire builder at the then prevailing wage of 10 cents an hour. In 1920, after service in World War I, he was named Dayton Rubber plant superintendant and has since moved up to positions of increasing responsibility.

Forms New International Subsidiary

A new subsidiary to be known as the Goodyear International Corp., has been incorporated to conduct the foreign business of the Goodyear Tire & Rubber Co., Akron, Ohio. The new subsidiary replaces the Goodyear Tire & Rubber Export Co. F. T. Magennis has been named president of the subsidiary with E. E. Long as vice-president. Mr. Magennis, who has been with the firm for nearly 40 years, was previously the vice-president and general manager of the export company. Mr. Magennis has been associated with the company's overseas operations for the past 38 years, spending considerable time in the Latin American countries. Mr. Long has been with Goodyear for 40 years and has served for 34 years in the overseas organization.

Opens Cleveland Sales Office

Jefferson Chemical Co., Inc., New York, N. Y., has announced the opening of a new sales office in Cleveland, Ohio. The new office, which is located at 802 Fidelity Building, is expected to facilitate purchases and technical services for Jefferson customers in the area. R. J. Robinson, who recently returned to Jefferson after two years with the U. S. Army Chemical Center, has been named resident sales representative. He is a graduate of Case Institute in Cleveland, with a degree in chemical engineering. Mr. Robinson will report to K. L. VanderVoort, newly appointed Chicago district sales manager.

Names in the News

E. J. Thomas, president of the Goodyear Tire & Rubber Co., has been elected a member of the board of trustees of the American Heritage Foundation.

J. V. Carlin, Jr., has been named general sales manager of the Acme Rubber Mfg. Co., Trenton, N. J., succeeding his father, J. V. Carlin, Sr., who has relinquished full scale responsibilities in this capacity.

James H. Brinckerhoff, formerly assistant district manager-wholesale for the Goodyear Tire & Rubber Co. at Boston, Mass., has been appointed assistant manager of retread and repair material sales in Akron, Ohio, succeeding Joseph C. Hofmann, Jr., who has been named manager of retread and repair materials.

Donald A. Handy, previously supervising engineer at Kenneth A. McIntyre Associates, Cleveland management and consulting firm, has been named manager of the newly-created Methods Department of the Seiberling Rubber Co.

Cyril P. Gamber, of the Quaker Rubber Division of H. K. Porter Co., Inc., has been elected to membership in the Controllers Institute of America.

C. E. Jones, vice-president and comptroller and a director of Seiberling Rubber Co., observed his 35th anniversary with the firm in January.

Lawrence H. Flett, consultant at the National Aniline Division of Allied Chemical & Dye Corp., has received an honorary membership in the American Institute of Chemists.

James C. Carter, former New York Packaging Films representative in the Films and Flooring Division of the Goodyear Tire & Rubber Co., has been assigned to Charlotte, N. C., in a similar capacity.

Richard Burhoe has been appointed St. Paul branch sales manager of the Industrial Trades Tape Division of the Minnesota Mining & Manufacturing Co.

Harry R. Stout, formerly assistant manager, has been named manager of the Credit and Collection Department of U. S. Rubber Co., succeeding Fred A. Schwarz, who has retired.

Stanley J. Dumovich, formerly a sales representative in the Chicago regional sales office of the Atlas Powder Co., has been transferred to the Houston, Tex., sales office, succeeding Latane deS. Lamb, who has resigned.

John R. Finn, has been named general sales manager of the Standard Products Co.

Robert D. MacDonald has been promoted from assistant manager of the Tape Research Department to manager of products control and development in the Retail Trades Tape Division of the Minnesota Mining and Manufacturing Co.

Herbert Schoenfield, previously technical sales service manager of the Emulsol Chemical Corp., has been appointed to the newly created position of manager of polyester sales in the Chemical Sales Division of Witco Chemical Co. with headquarters in the Chicago office.

Reginald L. Johnson has been elected vice-president of the Johns-Manville Sales Corp., succeeding H. M. Shackelford, who has retired after nearly 30 years' service with the firm.

James E. Brown, former internal auditor of General Aniline and Film Corp., has been named to the newly created position of manager-budgets and audits.

Charles R. Yerrick, previously industrial sales manager in the Great Lakes area for the Adhesives & Coatings Division of the Minnesota Mining & Manufacturing Co., has been assigned to the firm's eastern area as industrial sales manager.

Paul N. Leech, has been appointed sales representative in the Mid-Atlantic sales territory of Emery Industries, Inc., with responsibility for Emery's complete line of fatty acids.

John Reedy, associated with the International Packings Corporation for the past two years, has returned to the Garlock Packing Co., Palmyra, N. Y., as assistant chief chemist.

William E. Kavenagh, director of development and research for the Shoe Products Division of the Goodyear Tire & Rubber Co., has retired.

Alfred B. Lingley, who has been associated with the rubber field since 1920, has joined Bristol Mfg. Co. as advisor to the president on work layouts and methods.

Earl H. Bradley, president of B. I. F. Industries, Inc., was named to the board of directors of Ansonia Wire & Cable Co. at the annual stockholders' meeting.

Dr. E. A. Barr, previously assistant director of the Extruded Products Division of Bakelite Laboratories, has been appointed assistant manager of the New Product Engineering Department, where he will be concerned with the practical applications of new plastics and resins developed by the company's laboratories.

K. Jerry Morray, formerly sales and product planning specialist in the Chemical Materials Department of the General Electric Co., has been appointed manager of the Cleveland Sales District of the Silicone Products Department.

Walter J. Roider, Jr., previously assistant general manager of the Casein Department in the Chemical Division of the Borden Co., has been named general manager of the Casein Department.

V. C. McQuiddy, Jr., has been appointed to the new post of sales manager of textile products for the U. S. Rubber Co.

F. T. Magennis, recently named president of Goodyear International Corp., has been elected a director of the Goodyear Tire & Rubber Co.

William E. Cass, former manager of the New Product Development Laboratory of the Chemical and Metallurgical Division of the General Electric Co., has joined the staff of Arthur D. Little, Inc.

William T. Hepburn has been appointed manager of passenger tire sales for the Firestone Tire & Rubber Co., succeeding H. H. Vischer, who has been named manager of the Omaha, Neb., district.

George H. Callum has been appointed general sales manager of manufacturers' products in the footwear and general products division of U. S. Rubber Co., and William J. Mulvey, has been named to succeed Mr. Callum as sales manager of the company's Naugahyde vinyl coated fabrics.

George W. Raymond has been promoted from acting manager to manager of union relations (Akron) at the B. F. Goodrich Co.

William F. Diffenderfer, formerly on the packaging film sales staff of the Goodyear Tire & Rubber Co., has been appointed vinyl film field representative in New York.

Dale A. Dougherty has been appointed manager of industrial relations and industrial engineering for the Tyer Rubber Co., Andover, Mass.

Benjamin F. Lauderdale, former sales manager for Motor Supply Co., Oklahoma City, Okla., has been appointed sales representative for tread rubber products at the Lee Rubber & Tire Corp.

W. D. Lahey, previously manager of extrusion and molding materials at the B. F. Goodrich Chemical Co., has been appointed sales manager of adhesives for B. F. Goodrich Industrial Products Co.

Richard N. Wilson has been named an application engineer in the Allis-Chalmers Switchgear Department, where he will handle installations for the pulp and paper and rubber industries.

DuPree Appointed Vice-President

Sam DuPree

Sam DuPree, formerly general manager of the Industrial Products Division of Goodyear Tire & Rubber Co., Akron, Ohio, has been appointed vice-president of the general products group succeeding Joseph E. Mayl, whose retirement became effective January 31. R. B. Warren, former sales manager of Industrial Products has been appointed to the post vacated by Mr. DuPree. Mr. DuPree, a native of Woodstock, Ga., was graduated from the University of Georgia Tech., Atlanta, Ga., in 1931 with a degree in mechanical engineering. He joined Goodyear in 1934 in the company's production training squadron. Serving the firm in various capacities since that time, Mr. DuPree was appointed general manager of the Industrial Products Division in 1954.

In his new post, Mr. DuPree will coordinate activities of the company's Industrial, Aviation, Metal, Shoe and Foam Products, Films and Flooring Divisions and the government sales department. Mr. Warren joined the firm in 1927, after graduation from Ohio Wesleyan University in Delaware. Since then, he has received many promotions in the firm and during World War II, he served as assistant head of the Navy rubber director's office as lieutenant-commander. He was promoted to sales manager of Industrial Products in June, 1956. Mr. Mayl, retired vice-president of the general products group, had been with Goodyear since 1924, when he started as assistant manager of the firm's Truck Tire Department. In the top level management reorganization, announced by Goodyear in April, 1956, Mr. Mayl was appointed subsidiary vice-president to coordinate activities of the company's general product divisions.

Campco Licenses German Firm

Campco Division, Chicago Molded Products Corp., Chicago, Ill., has announced that Deutsche Tafelglas A. G., Furth/Bavaria, Germany, has been licensed to manufacture and supply thermoplastic sheet in Germany. Under the licensing arrangement, Campco will train Deutsche Tafelglas A. G. representatives, in this country, in technical and merchandising methods. The two firms will also exchange ideas and machinery.

Ozone Deterioration Reports

Two reports have been published by the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., describing Army Ordnance Corps research on the protection of rubber against deterioration caused by ozone attack. The first report, PB 121480, states that the incorporation of chemical ozone inhibitors and wax into formulations during manufacture of rubber tires is recommended as the most effective method of protecting the tires in long-term outdoor storage against light-energized oxidation and cracking by atmospheric ozone. Entitled *Preservation of Tires in Outdoor Storage*, by W. J. Touhey, Rock Island Arsenal Laboratory, U. S. Army Ordnance Corps, the 36-page volume was published in May, 1953, and is priced at $1.00.

Antiozonants in Oil Extended and Plasticized GR-S Vulcanizates, by E. W. Bergstron, Rock Island Arsenal Laboratory, U. S. Army Ordnance Corps, describes research in which oil extended and plasticized GR-S vulcanizates were evaluated for resistance to ozone attack after addition of antiozonants known to protect unplasticized vulcanizates. Published in December, 1955, PB 121501 is a 21-page volume priced at 75c.

Forms Cellular Plastics Group

Committee D-20 on Plastics of the American Society for Testing Materials has organized Subcommittee XX on Cellular Plastics to develop standard methods for measuring the physical and chemical properties and specifications for various types and grades of cellular plastics. The subcommittee has organized a section to develop test methods, and other sections to develop specifications for polyurethane, polyvinyl chloride, polystyrene and polyethylene cellular plastics. I. T. Stoneback, of Telecommunication Laboratories, is chairman of the subcommittee and Betty Lou Raskin, of the Johns Hopkins University Radiation Laboratory, is secretary. Those interested in participating in the development of standards for cellular plastics may write to I. T. Stoneback, chairman ASTM Communication XX on Cellular Plastics, Federal Telecommunications Laboratories, Nutley, N. J. The group is holding its next meeting during the latter part of February in Roanoke, Va.

Sets $150 Million Expansion

Borden Co., New York, N. Y., has announced a $150,000,000 expansion program to take place over a period of five years from 1957 to 1961. During 1957, Borden plans to undertake an intensive analysis of its operations with the assistance of constructive criticisms from company employees who have been asked to cooperate in the program. A highly intensified advertising and promotional program will also take place. The Borden Co., founded in 1857, is celebrating its centennial this year.

Take issue with something in this edition? Write a letter to the editor! (See page 940).

Williams Joins Emery Industries

George R. Williams

Emery Industries, Inc., Cincinnati, Ohio, has announced the appointment of George R. Williams as sales representative in the New York City area. Under the direction of J. W. Ritz, eastern district manager, Mr. Williams will handle Emery's line of organic chemicals, including dibasic acids, polymerized acids, plasticizers, fatty esters, lubricant esters, etc. Mr. Williams holds a B.S. degree in physical science from the University of Chicago and a B.S. in chemical engineering from the University of Wisconsin. Before joining Emery, he was the Cincinnati area sales representative for Merck & Co., Inc.

Names Executive Plant Manager

Paul W. Kollar has been appointed executive plant manager of Anchor Rubber Products, Inc. and Doan Manufacturing Corp., both of Cleveland, Ohio. Mr. Kollar will be in charge of all production facilities and manufacturing processes of Anchor and Doan plants. With 35 years of experience in chemical engineering, product management and administration, Mr. Kollar most recently headed his own consulting company, specializing in the re-organization and building of manufacturing operations. He has a degree in chemical and electrical engineering and attended the Harvard School of Business. During his career, he has held various positions from chemical engineer to corporation president. He was formerly associated with such firms as U. S. Rubber, Firestone, General Tire, and the Texas Plastic Development Corp., Houston, Texas.

Acquires 47% of NRM Common

American Seal-Kap Corp., Delaware, has announced the acquisition of approximately 47 per cent, or about 91,911 shares of common stock of National Rubber Machinery Co., Akron, Ohio. American Seal-Kap said the stock was acquired in the open market during 1956, but did not announce the acquisition cost. According to current reports, the average price of National Rubber Machinery shares on the American Stock Exchange last year was $30.75. On this basis, the acquisition cost would be about $2,800,000.

Financial News

GOODYEAR EARNING IN 1956 SET ALL-TIME COMPANY HIGH

Earnings of the Goodyear Tire & Rubber Co. for 1956 were the highest in the company's 58-year history, totaling $62,456,130, it was announced recently by E. J. Thomas, president, and P. W. Lichtfield, chairman of the board. Although sales to the automotive industry were down from the previous year, Goodyear's total sales in 1956 practically equalled the all-time record of 1955. Sales of $1,358,763,538 last year compared with $1,372,176,139 the year before. It was the sixth year in succession that sales topped the billion dollar mark.

Last year's record net income represented a gain of 4.7 per cent compared with $59,665,845 reported for 1955. The 1956 earnings were equal to $6.02 per share on 10,361,605 shares of common stock outstanding at the year-end, compared with $5.76 per share for 1955, based on the same number of shares.

The 1957 business year, the Goodyear executives said, seems to hold out the opportunity for higher volume for all of the company's products here and abroad. Prospects are for higher production of new cars, and the number of vehicles running on the roads is increasing steadily. The new highway program, as it comes into being, will help insure that this trend will continue.

Capital Expenditures

Goodyear's capital expenditures on property for expansion, improvements and replacements totaled $88,850,592 last year compared with $70,079,033 the year before. Substantial additions and improvements were made in producing and distributing facilities for tires, industrial goods, films, Airfoam, flooring, steel products, chemicals, plastics and aviation products. New tire plants were completed in Colombia, Venezuela and the Philippines, and a new plant was built in North Chicago for hose manufacture. A new distribution center at Cleveland, Ohio, with 15 acres under roof, was also completed during the year.

The company's synthetic rubber plants at Akron, Ohio, and Houston, Texas, are being increased by at least 50 per cent, bringing capacities up to 241,000 long tons annually, according to the report. These plants will take care of the company's own needs plus substantial sales to other users. Goodyear is also part-owner of a synthetic plant now being built in England.

The company reported progress during the year in its research efforts to develop a new synthetic which will more nearly duplicate the properties of natural rubber for all uses. This new Goodyear rubber is called Natsyn. A larger pilot plant is now being built for its production, the Goodyear executives reported, and the outlook continues very promising.

During the year, Goodyear consolidated most of its wholly-owned domestic subsidiaries with the parent company, effecting a substantial reduction in the Federal tax on inter-company dividends, as well as other economies.

Profits of foreign subsidiaries included in consolidated net income amounted to $17,503,887 last year compared with $18,655,745 the year before. To adjust foreign current assets to prevailing rates of exchange, a charge for devaluation of $1,556,000 was made to the reserve for foreign investments.

Domestic funded debt was reduced $4,200,000 during the year and the $50,000,000 balance of the revolving bank credit arranged in 1952 was canceled. Working capital at the year-end was $451,333,260 compared with $460,552,750 a year earlier. U. S. and foreign income taxes in 1956 totaled $66,299,000, equivalent to $6.40 per share of common stock, compared with $66,966,000 or $6.46 per share in 1955.

Aetna Standard Engineering Co.

Six months to December 31, 1956. Net income of $647,717, which is equal to $1.40 a share, compared with $558,573, or $1.21 a share, in the same period of 1955. Net sales in the last six months of 1956 totaled $20,513,413 against $14,553,002 in the comparable period of 1955.

Lee Rubber & Tire Co.

Quarter to January 31, 1957: Net income of $336,417, which is equal to 40 cents per share, compared with $312,795, or 37 cents a share, in the same period last year. Net sales in the first three months of fiscal 1957 totaled $10,612,968 compared with $10,845,626 in the 1956 three month period.

Mohawk Rubber Co.

Year to December 31, 1956: Net income of $370,525, which is equal to $2.62 a common share, compared with $321,068, or $2.27 a share, in the previous year. Net sales in 1956 totaled $15,126,701 compared with $14,330,371 in fiscal 1955.

Watson-Standard Co.

Year to November 30, 1956: Net income of $159,350, which is equal to $1.06, compared with $151,477, or $1.07 a share, in fiscal 1955.

Thiokol Chemical Corp.

Nine months to September 30, 1956: Net income of $609,598, compared with $395,211 in the 1955 nine month period.

GOODRICH 1956 PROFIT DROPS REFLECTING 4.1% LESS SALES

Net sales of the B. F. Goodrich Co., in 1956 amounted to $724,168,401, compared with $755,016,879 for the year 1955, a decrease of 4.1 percent, John L. Collyer, chairman, and W. S. Richardson, president, reported recently. Direct and indirect sales to the Federal Government were 5.4 percent of total net sales for the year 1956 compared with 5.8 percent for the year 1955. Net income in 1956, after provision for all costs, including taxes and depreciation, amounted to $43,765,431 as compared with $46,662,127 in 1955. Net income a common share was $4.90 compared with $5.26 a common share in 1955.

Earnings of associate companies (not consolidated) in which Goodrich owns less than majority interests are included in the net income only to the extent of dividends paid during the year by these companies. Increases in Goodrich equity in net income retained by associate companies and not included in the Goodrich consolidated net income amounted to $3,947,000 for the year 1956 and $3,075,000 for the year 1955.

Dividends totaled $2.20 a share in the year 1956, which compares with $1.90 a share in 1955. Total dividend payments to stockholders were $19,604,157 in 1956 and $16,803,002 in 1955. Net income was 6.2 percent less than in 1955 as a result of lower sales and a lower margin between selling prices and costs. The net sales decline of 4.1 percent below 1955 was due largely to the reduction in passenger car production in the United States from 7,920,000 in 1955 to 5,800,000 in 1956. The sales of several of the company's products were affected. Also adversely affecting sales and net income were reduced selling prices of "Geon" vinyl resins and certain other products.

Federal and Foreign Taxes

Federal and foreign income taxes for the year 1956 were $43,082,000 as compared with $48,330,000 in 1955. All taxes, including excise and other taxes, amounted to approximately $86,846,000 in 1956, equivalent to $9.72 a share on 8,931,680 common shares, as compared with $89,095,000 in 1955, equal to $10.04 a share on 8,871,068 common shares. Depreciation and amortization of leasehold improvements in 1956 amounted to $19,468,957 as compared with $19,677,643 in 1955.

Capital expenditures and investments during 1956 for the modernization and expansion of manufacturing, distribution, and research facilities of Goodrich and investments in associate companies, amounted to $37,006,000. Capital expenditures and investments during 1955 were $30,294,000.

Current assets at the end of 1956 were $343,640,370 and current liabilities were $98,497,305, a ratio of 3.5 to 1. Net working capital was $245,143,065 at year end compared with $241,152,107 at the end of 1955.

Inventories at year end amounted to $147,258,710 compared with $147,345,672 at the end of 1955. Domestic inventories of man-made and crude rubber and rubber-like materials have been priced on the last-in, first-out (LIFO) basis in both years.

GENERAL TIRE 1956 SALES HIT HIGH OF $390,471,772

Consolidated sales of the General Tire & Rubber Co. for the year ended November 30, 1956, reached an all-time high of $390,471,772, William O'Neil, president, announced recently in his annual report to stockholders. It was the seventh consecutive year that General Tire's consolidated sales have exceeded the previous year's record. The 1956 sales, which do not include those of the wholly-owned subsidiary, RKO Teleradio Pictures, Inc., nor those of operations outside of the United States except General's Canadian operations, were an increase of $94,740,676 over 1955, the company's best previous year.

While the RKO Teleradio sales are not included, the earnings of the broadcasting-motion picture-music subsidiary are being consolidated, it was reported by Mr. O'Neil. He said: 'Because of the increasing importance of RKO Teleradio, its net earnings are now being included in our consolidated statements for the first time. Actually, due to customary delay in foreign audits, we are able, at this time, to include the RKO Teleradio earnings only for the 10-month period through September 30. Unaudited figures indicate that RKO Teleradio in October and November showed additional profits of approximatly $1,000,000.

"We are not consolidating RKO Teleradio sales in our figures because they are not tangible merchandise. This is an equity type consolidation, hence, our traditional pattern of reporting sales has not been changed. Thus, our consolidated earnings, including RKO earnings for only 10 months, are $10,860,129. This amounts to $6.90 per share. Also not included in this figure are the undistributed earnings in our foreign subsidiary and affiliated companies which enjoyed an outstanding year in both sales and earnings." If it had been possible to include a full year's earnings of RKO Teleradio, the Company's overall earnings would have exceeded those of 1955, it was pointed out.

Cites Acquisition Of Byers

The General Tire president reported that the company's acquisition last September of a majority of the voting stock of the A. M. Byers Company, of Pittsburgh, through an exchange of stock, has proven to be a good investment. "With our entry into the company, unity has been restored and the trend of losses in 1954, 1955 and the first half of 1956 was reversed, with the year's end showing a profit," he said.

Mr. O'Neil also said that steps were taken in 1956 towards making the company's preference stock its senior stock. "The plan was initiated by retiring more than $6,000,000 of cumulative preferred stock through exchanging either subordinated debentures or preference stock for it. Less than $800,000 of cumulative preferred stock now remains outstanding. In addition, plans for consolidating certain series of our preference stocks are now under consideration," he told the stockholders.

Pointing to the company's tremendous growth, Mr. O'Neil said: 'We project sizable gains in sales and profits in all our basic operations—rubber, plastics, chemicals, rockets and entertainment—in 1957. In anticipation of this increased demand we completed or began major expansion during 1956 as part of a $40 million, two-year capital expenditure program."

As of November 30, 1956, General's working capital was $68,944,065 as compared to $52,399,145 a year previous. Its current assets are $147,028,874 and its current liabilities are $78,084,809.

General's new, completely-integrated synthetic rubber plant at Odessa, Texas, will go into operation in the third quarter of 1957, it was announced.

Muted Refuse Trucks

Contributing to a quieter city, the Sanitation Department of New York City is installing rubber strips on hoppers of its 1,400 waste-collection trucks. The program to equip trucks with strips that deaden noise when Sanitation Department men empty garbage cans is more than half completed. The Sanitation Commissioner has reported that all the department's trucks would be so equipped by the end of the year.

Minnesota Mining & Mfg. Co.

Year ending December 31, 1956: Net income of $38,437,684, which is equal to $2.30 a common share, compared with $34,323,370, or $2.07 a share in 1955. Consolidated sales in 1956 were $330,807,692 against $281,860,717, the year before. In its annual report to stockholders, the company cited 1956 as one of its "best and busiest years". Consolidated sales have nearly doubled in the past five years and climbed by about $100,000,000 in the past two years, the report says. A slight decline in the ratio of net income to sales (11.7 percent in 1956 compared with 12.3 percent in 1955) had been anticipated and was due mainly to lower profit margins of newly acquired subsidiaries and partially to price reductions in some of the parent company's lines.

Baldwin Rubber Co.

Six months to December 31: Net income of $376,062, which is equal to 87c per share. Net sales for the last six months of 1956 were $7,160,002.

Prepared especially for design engineers, a new brochure available from the Enjay Co., New York, N. Y., presents an objective summary of some of the properties and applications of Enjay Butyl Rubber.

ELASTOMER AND PLASTICS GROUP HEARS HULSE ON POLYETHYLENE

Approximately 85 members and guests of the Elastomer and Plastics Group of the Northeastern Section, American Chemical Society, attended the January 15th meeting held at the regional office of the Goodyear Tire & Rubber Co. at Needham Heights, Mass. Principal speaker of the meeting was Dr. George E. Hulse of the Spencer Chemical Co., who spoke on "The Newer Polyethylene".

Dr. Hulse reviewed the development of the latest high temperature and high pressure process for the manufacture of polyethylene. The variations possible in chemical structure of these new polymers have a more significant effect on resultant physical properties than with many other polymers, he stated. It was shown by series of tabulated data that the physical properties are related to the weight average and number average molecular weights of the polymers. However, in choosing a resin to meet specific property requirements, these relationships must be used carefully since it is frequently necessary to limit the favorable feature of the material in order to strike abalance on the best over-all properties.

A table showing a comparison of melt index and density properties between the conventional polyethylenes and the newer types was introduced. From these figures, it could readily be seen what would be the preferred uses for each type. Wire insulations, where toughness is an advantage probably will continue to use the older types, whereas injection molders will undoubtedly prefer the newer types where rigidity and gloss are important.

Resin Manufacturing Methods

Dr. Hulse discussed three methods currently employed to manufacture these new resins and mentioned the characteristics of the various catalysts used. In conclusion, he predicted that by 1960 one billion pounds of polyethylene, including seven hundred million pounds of high pressure process resin would be sold. It is expected by then that present consumption on coatings and film would increase two and one half times, on pipe it would double, on wire insulation it would triple, and on polyethylene bottles would increase five fold.

The lively question period following, covered such subjects as polyethylene emulsification, propylene polymerization, compounding of the polymer including antioxidants, polyethylene fibers, stress-cracking and embrittlement of the resin in service, use of peroxides for thermalsetting properties, effect of radiation on the polymer and non-aqueous dispersions and solvents.

Visits Midwestern Territory

William T. Baird, president of the Baird Rubber and Trading Co., Inc., New York, N. Y., accompanied by Mrs. Baird, has taken a month long trip to visit the firm's friends, customers and business associates west of the Mississippi River. Mr. Baird expects to return to New York in mid-March.

News in Brief

Technical Service Laboratory Bulletin No. GD-18, issued by the Research Laboratories of Godfrey L. Cabot, Inc., discusses the use of Vulcan 9, Super Abrasion Furnace (SAF) black, for butyl curing bladders in automatic tire vulcanizers.

Isotopes Specialties Co., a subsidiary of Nuclear Corp. of America, has been appointed a licensed disposal agency for radioactive waste.

Manufacturing Chemists Association, Inc., 1625 Eye St., N.W., Washington 6, D. C., has published a twelve-page booklet that gives properties and essential information for the safe handling and storage of antimony chloride.

A new catalog sheet, illustrating and describing two new Valve Pak assortments, which contain all the valves, extensions, and tools necessary for servicing tubeless tire valves, has been released by the Dill Manufacturing Co., 700 E. 82nd St., Cleveland 3, Ohio.

R. G. Le Tourneau, Inc., has developed a new line of hoists requiring 37 per cent less headroom and offering precision load control to within .008 of an inch.

Marblette Corp. has developed two new coating resins "Mareset Grey Enamel No. 750" and "Clear Varnish No. V-760", for surfaces and finishes exposed to corrosives and adverse weather and atmosphere conditions.

Pollard Brothers Manufacturing Co., Chicago, Ill., has released a new illustrated catalog describing its line of storage racks. Ask for Catalog No. 303.

"Guidance and the Scientific Manpower Shortage", which appears in the March issue of *American School Board Journal*, reveals the results of a study, made by Scientific Apparatus Makers Association, investigating the basic causes for the shortage of scientists.

Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton 7, N. J., has issued a portfolio on butyl rubber developments that gives information on market developments in butyl rubber; a technical bulletin on evaluation of butyl accelerators (sulfur type); a study of carbon black in butyl rubber; a types and properties chart and a sketch of Thiokol butyl sales and technical organization.

Protective Coatings, Inc., Tampa, Fla., has released a comprehensive chart listing all architectural, industrial and marine surfaces with recommended liquid plastic coatings and a supplementary chart covering comparative performances, application methods and cost of most liquid plastics.

Anchor Adhesives Corp. has announced the development of a new adhesive, "No. 452 Tuftbond" for cementing fabrics directly to foam rubber.

Service Managers Committee of the Rubber Manufacturers Association, Inc., 444 Madison Ave., New York 22, N. Y., has released a single-page, illustrated bulletin dealing with problems of mounting and demounting tubeless tires on new types 14 and 15 inch rims.

Minnesota Rubber and Gasket Co. has issued a template-ruler that permits faster and more accurate drawings of the firm's Quad-ring seal.

Dayton Rubber Co. has developed a "Costimator" to enable users of foamed-in-place urethane formulations to calculate material costs quickly and simply. Write Department 72.

Taylor Stiles & Co., Riegelsville, N. J., has issued a folder on its 700 Series Plastic Pelletizers which are said to cut pellets of uniform size at the rate of 10 tons an hour.

Stauffer Chemical Co. has announced that the company is manufacturing titanium trichloride, which was previously available only in small quantities, on a semi-commercial basis.

Two Goodyear Chemical Division field offices have been moved to new quarters. The Boston office is now located at 66 B Street, Needham Heights 94, Mass., and the Cleveland office is located at Goodyear's new distribution center at 7007 Brook Park Road, Cleveland 29, Ohio.

Bond Adhesives Co., has moved to new and larger quarters in Jersey City, N. J. The firm's new mailing address is Box 406, Main Post Office, Jersey City 2, N. J.

"Sealgrip," a new adhesive for use in the manufacture of belts and handbags, which forms a strong bond after application on only one surface, has been developed by Adhesive Products Corp.

General Aniline & Film Corp. has released a new data sheet entitled "Adhesives and Coatings from Vinyl Ether Polymers and Copolymers," which discusses the applications of a series of four related polymers in the compounding of new adhesive and coating formulations.

Rubba, Inc., has developed "Rubbaseal," a new self-sealing adhesive for use in the manufacture of self-sealing envelopes, which requires no moistening and which retains its adhesive qualities indefinitely.

A new flame-resistant flocking adhesive called "Flok-Grip," has been developed by Adhesive Products Corp., for bonding decorative materials such as cotton, wood, glitter, confetti, etc. to such bases as natural wood branches, leaves, evergreens and artificial flowers.

Carbide and Carbon plans expansion of the company's facilities at South Charleston, West Va., to double the production of morpholines.

A completely revised, condensed 28 page catalog (C-5000, Rev. 8) covering meters, regulators and valves has been introduced by the Rockwell Manufacturing Co., 400 N. Lexington Ave., Pittsburgh 8, Penna.

The Coatings and Adhesives Department of the Chemical Division of the Borden Co., has released a descriptive folder to introduce the company's line of "Placco" plant and maintenance materials.

A new illustrated catalog discussing more than 115 different applications for silicones has been published by the Silicone Products Dept., General Electric Co., Waterford, N. Y. Ask for Catalog CDS-97.

"Hydraulic Presses for the Rubber and Belt Industry", a new 4-page bulletin, is available from the R. D. Wood Co., Philadelphia 5, Penna.

The Chemical Division of the Borden Co. is now offering an illustrated folder describing the proper use of contact cements for home, office and furniture improvement.

A new brochure describing continuous, non-contact diameter measurement and control equipment for insulated wire and cable and extruded tubing and shapes has been released by Industrial Gauges Corp., West Englewood, N. J.

The February issue of *Advance Headlines*, issued by Advance Solvents & Chemical, New Brunswick, N. J., gives a comprehensive report on stabilizers offered by the company.

What is said to be the largest conveyor belt ever made in one piece, measuring 1,000-feet long by 60-inches wide, has been developed by the B. F. Goodrich Industrial Products Co.

Fort Wayne Group Meets

The Fort Wayne Rubber and Plastics Group held its third meeting of the 1956-57 season on February 7 at the Hotel Van Orman in Fort Wayne, Ind., with approximately 150 members and guests in attendance. Principal speaker of the meeting was James Roach of the Phillips Chemical Co., who delivered a paper on "Marlex 50 and Polyethylene." Mr. Roach utilized slides to illustrate his talk. At the meeting, the Nominating Committee reported on its selections of officers for the 1957-58 meeting and these selections will be voted on prior to the next scheduled meeting of the group on April 11.

de Decker Named to New Post

Dr. H. K. J. de Decker

Texas-U. S. Chemical Co., New York, N. Y., has announced the appointment of Dr. H. K. J. de Decker, to head the polymer research section of the Research and Development Department, and Dr. Walter Nudenberg as head of the company's exploratory chemical research section. Dr. de Decker, a native of Belgium, was formerly research director of Holland's Rubber-Stitching Research Institute. In this capacity, he headed a research group which developed a statistical design for measuring tire tread wear, developed processes for the preparation of plastics from natural rubber latex and processes for improving the uniformity, production costs and flame resistance of foam rubber. He has also been associated with the Royal Dutch Shell Petroleum Co., the Netherlands Organization for Applied Scientific Research and for a time, he was on the staff of Amsterdam University.

Dr. Nudenberg, a native of Newark, N. J., received his bachelor's and master's degrees in chemistry from Bucknell University and his doctorate in organic chemistry at the University of Chicago. From 1941 to 1943, he was employed at the Beltsville, Md., research center of the U. S. Department of Agriculture. He then joined the University of Chicago as associate professor in the Chemistry Department. During World War II, he was associated, at the University, with the government-sponsored research program devoted to the development of GR-S rubbers. He holds a number of patents and has written numerous technical papers in the field of free radical, hydroperoxide and polymer chemistry. He is a member of the American Chemical Society and Sigma Xi.

Akron Chemical Names Officers

Akron Chemical Co., Akron, Ohio, has announced the promotion of V. K. Hitch from vice-president to executive vice-president and the appointment of Richard L. Silver and R. Bruce Silver as vice-presidents at the organization's annual meeting. Other officers of the firm are: J. R. Silver, Jr., president; Harold M. Whitacre, vice-president, and Helen Mittelstaedt, secretary-treasurer.

More Names in the News

Dr. Wladimir Philippoff, principal scientist at the Franklin Institute Laboratories for Research, Philadelphia, Penna., has been appointed chief of the Rheology Section, which was recently established in the Chemistry and Physics Division of the laboratories.

James W. Sweeney has been promoted from sales supervisor in the Cleveland and Detroit areas for the Minnesota Mining & Manufacturing Co., to sales manager of the Industrial Trades Tape Division at the Dallas branch.

A. P. Austin has been appointed sales manager of the paints division of Canadian Industries Ltd., to succeed F. H. Giroux, who has retired after 46 years with the company.

J. C. Findlan, formerly field representative for the Geigy Industrial Chemical Division of Geigy Chemical Corp., Ardsley, N. Y., has been appointed sales manager of the division.

J. Nelson Manning, Jr., has been named general production manager of the Clothing Division of Sawyer-Tower, Inc., where he will be responsible for all problems relating to coating, stitching, sub-contracting and finishing.

Frank Davis, former special key industrial engineer, has been named manager of Time Study and Methods for B. F. Goodrich Aviation Products.

Thomas F. Cockrem, assistant manager of highway transportation at the Goodyear Tire & Rubber Co., has been assigned to the post of manager, succeeding George M. Sprowls, who has retired following 44 years with the firm.

A. W. Roat, formerly on the sales staff of the Fielden Instrument Division of Robertshaw-Fulton Controls Co., New York, N. Y., has been appointed applications engineer of the controls sales section in the company's Fulton Sylphon Division.

Frank B. Norton, former sales director of the Firestone Tyre & Rubber Co. of India, Ltd., has been appointed sales manager of Firestone International Co.

Jack E. Davis, previously on the Philadelphia branch sales staff of the Diamond Alkali Co., has been promoted to the post of special staff assistant in the company's Sales Department.

Edward M. Bader, section manager of the Statistical Quality Control Section in the B. F. Goodrich Works Technical laboratories, has been named manager of Quality Control and Inspection for B. F. Goodrich Aviation Products.

Interested in the Washington scene? Make sure to read "Capitol Cues" on page 953!

Appointed Akron Office Manager

Warwick McCutcheon

Warwick McCutcheon has been named manager of the new sales office in Akron, Ohio, recently opened by the J. M. Huber Corp. of New York, N. Y. Sales of Huber carbon blacks, clays and chemicals for the rubber industry in Ohio and Eastern Michigan will be handled at this office. With the opening of the Akron office, Huber representatives will call directly in all areas with the exception of the West Coast, New Jersey and eastern Pennsylvania. These territories will continue to be serviced by H. M. Royal, Inc.

Dayton Light-Weight Truck Tire

Dayton Rubber Co., Dayton, Ohio, has developed a five-rib tubeless truck tire which is said to be the lightest in weight produced for rugged highway service. According to the company, this new feature should provide greater pay load capacity and extra mileage. Improved Super-Cordura rayon cord construction was used to reduce weight while maintaining full carcass strength. The eight-ply, 12-ply rating tire is said to be stronger than conventional 12-ply rated tires and even lighter than premium-priced nylon tubeless tires of the same size and ply rating. Each 11-22.5 tubeless tire and demountable rim assembly averages 34 pounds lighter than the customary 10.00 tube-type tire and rim assemblies replaced. On a 14-wheel tractor and tandem trailer, the weight saving would be approximately 476 pounds. Designed for long fast hauls with heavy loads, the extra mileage tread features wide ribs that put over eight per cent more rubber to work for slower, safer, more even wear, the company says.

Minnesota Mining Appointments

Minnesota Mining & Manufacturing Co., St. Paul, Minn., has announced the formation of a new Engineering and Staff Manufacturing Division. Cyril P. Pesek, formerly vice-president for engineering, has been named vice-president for engineering and staff manufacturing. Harold W. Rehfeld, who directs staff manufacturing, will henceforth report to Mr. Pesek, and will assist him in the administration of staff manufacturing, divisional engineering and administrative engineering.

Naugatuck Appoints Two

Two changes in the executive staff of the Naugatuck Chemical Division, U. S. Rubber Co., have been announced by George R. Vila, newly elected vice-president and general manager. Earle S. Ebers, formerly general sales manager, has been appointed assistant general manager of the division, the post previously held by Mr. Vila. Harold M. Parsekian, who was assistant general sales manager, has been named general sales manager. Mr. Ebers joined the rubber company in 1937 as a research chemist in its general laboratories. In 1946 he became plastics development manager for the chemical division. He was named sales manager for Kralastic and Vibrin resins in 1949, and four years later was appointed director of research and development for the division. In 1955 he was named general sales manager.

Mr. Parsekian joined the rubber company in 1949 when it purchased the chemical division of Glenn L. Martin Co., where he was director of sales and technical service. His first post was manager of Marvinol resin sales. He became manager of plastics sales in 1953, and the following year was appointed assistant general sales manager.

Form Research Partnership

A research partnership has been formed between Ionics, Inc., Cambridge, Mass., and Diamond Alkali Co., Cleveland, Ohio, through which Ionics will undertake, under the sponsorship of Diamond, substantial and varied chemical research programs. In this transaction, Diamond Alkali Co. has purchased 25,000 shares of Ionics' stock from the American Research and Development Corp., Boston, Mass., the company's founder and largest stockholder. Current plans call for research to continue at Ionics' Cambridge facilities, in close cooperation with Diamond's research and development staff at Painesville, Ohio. According to the companies, this relationship will not affect continuing independent activities of Ionics in the fields of water conditioning, ion exchange treatment of sugar solutions and other already established ion exchange and membrane applications. Ionics will also continue to work with the Atomic Energy Commission and certain other private groups.

Borden Moves Leominster Units

Borden Co., New York, N. Y., has announced that the Monomer-Polymer Laboratories of the Chemical Division and the Dajac Laboratories for custom organic syntheses, have been transferred from Leominster, Mass. to 5000 Landon St., Philadelphia, Penna. Both laboratories are under the direction of Dr. K. C. Tsou. Included in the new facilities are research development and production laboratories for the custom preparation of specialty monomers and polymers and a pilot plant, which is being installed, for the initial production of new products in drum quantities.

Have some comments to make? Write a letter to the editor. (See page 940).

Mylar Bonding Process Developed

A new process for bonding "Mylar" polyester film to other rigid and flexible materials, including steel and aluminum, has been developed by Seiberling Rubber Co., Akron, Ohio. The film may be bonded with embossed surfaces in large patterns with deep grooves and ridges, the company says. Sheet metal covered with Mylar by the Seiberling process can be shaped with its surfacing already applied, thus eliminating rehandling. A thermo-setting adhesive, plus a special combination of time, heat and pressure are used to achieve the bond. Once the bond is cured and set, it will not soften with reheating.

Isotope Branch Office Opened

Isotope Products, Inc., Buffalo, N. Y., has opened a New England branch office at 5 Pickett St., Marblehead, Mass., under the direction of David R. Kneeland. The phone number is Neptune 5052. Located to permit more effective service to meet the increased need of New England industry, this office is another step in the expansion of Isotope Products. Mr. Kneeland, formerly manager of the firm's West Coast branch, has been associated with Isotope Products for many years and has had wide experience in industrial electronics and radiation gaging.

Plans $200,000 Expansion

Berea Rubber Co., Berea, Ky., has announced plans for a $200,000 addition. The project has been approved by the parent firm, Parker Appliance Co., Cleveland, Ohio, and work on the addition was scheduled to have begun in February. The addition, which should be completed in June, will increase storage, maintenance and press-line facilities. No increase in employment is anticipated.

Study Treatment Of Coated Cloth

Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., has released a report covering Armed Forces research on rot-resistant coatings for rubber-coated cotton fabrics, entitled *Evaluation of Rot-Resistant Treatments for Elastomer-Coated Fabrics*, by J. M. Ashcroft, Engineer Research and Development Laboratories, Corps of Engineers, U. S. Army. PB 121420 deals with a project undertaken to identify a rot-resistant treatment most suitable for rubber-coated cotton textiles. Experiments were made to determine whether treatment of the base cotton fabric with a fungitoxicant prior to coating would produce reciprocal effects detrimental to the coating, the fungitoxicant or the base fabric. The 51 page volume is priced at $1.25.

Washington Hears Garvey

The February 13th meeting of the Washington Rubber Group held in the auditorium of the Pepco Building in Washington, D. C., heard an address by Dr. B. S. Garvey, Jr., manager of the rubber sales service laboratory for Sharples Chemicals, Inc., now a division of Pennsalt Chemicals. Dr. Garvey chose as his subject, "Accelerators—Why and How". In his paper, the speaker discussed why accelerators are used with natural and butadiene rubbers. His paper dealt with the practical basis of selection and compounding rather than with the chemistry involved.

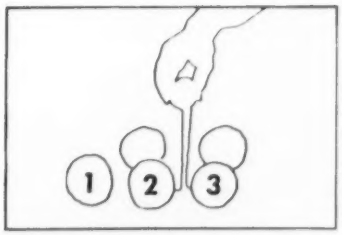
Linear Moves Operations

Linear, Inc., Philadelphia, Penna., has moved its operations to Dallas, Penna. The plant formerly occupied by the company, located at 6400 State Road, Philadelphia, Penna., has been placed on the market for lease or sale.

"Finally found Snedley a job he likes!"

Non-staining extending oil

For light-colored rubber



Iron Pyrophosphate Recipe
1. GRS-1707
2. Base Polymer (top) and Dutrex Oil Masterbatch (37.5 phr.)

Sulfoxylate Recipe
3. Base Polymer (top) and Dutrex Oil Masterbatch (37.5 phr)

Shell Dutrex 33 is an entirely new light-colored, compatible naphthenic extender for butadiene-styrene rubber. The outstanding non-staining, non-discoloring properties of Dutrex 33 are retained in oil masterbatch vulcanizates even after severe sunlight exposure.

Dutrex 33* provides superior light color in oil masterbatch based on conventional iron pyrophosphate recipes, but its maximum advantages are fully realized in sulfoxylate base polymers. Regardless of recipe, Dutrex 33 is recommended in oil masterbatch for applications where discoloration and contact or migration staining are critical.

For further information write or call Shell Oil Company, 50 West 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, California.

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...who have had cancer and are well and happy today because of the progress that has been made in cancer control. In their faces you will find the message of hope that is the American Cancer Society's perennial inspiration and challenge.

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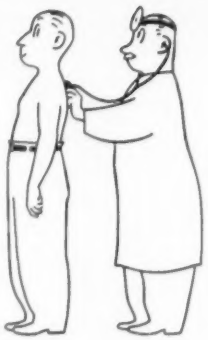
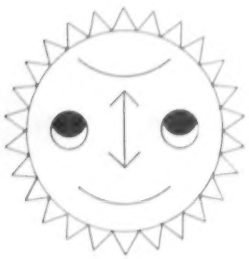
day-to-day policy:

See your doctor *immediately* at the first sign of any of the seven danger signals that may mean cancer.



About 1 in 4 of us living today will develop cancer at some time in our lives.

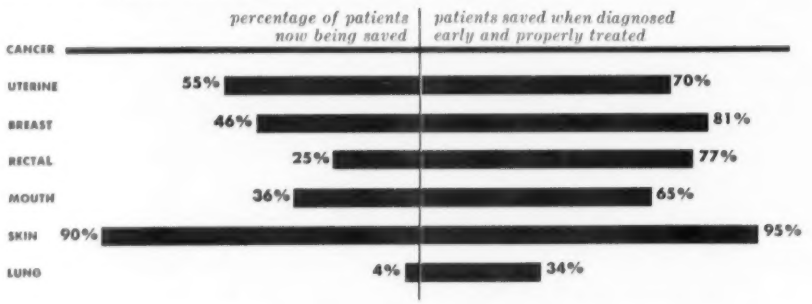


LET'S LOOK AT THE BRIGHTER SIDE

Cancer is much more curable than it was even 10 years ago. Approximately 150,000 Americans are being saved every year.

More and more people are going to their doctors *in time*. In fact, today one out of every three cancer patients is being saved annually. Formerly only one out of four was saved. This amounts to an additional 30,000 lives saved every year.

MANY MORE THOUSANDS COULD BE SAVED



(Estimates based on reports to the Third National Cancer Conference that included comprehensive data from the Connecticut State Department of Health, as well as the records of many hospitals, clinics, and other medical sources. The figures are believed to be sound estimates for most of the United States).

7 "LIFE-SAVING" SIGNALS

These seven so-called "danger" signals of cancer have, in reality, been seven *life-saving* signals to hundreds of thousands of Americans who have gone to their doctors at the first sign of any one of these:

1. ANY SORE THAT DOES NOT HEAL
2. A LUMP OR THICKENING IN THE BREAST OR ELSEWHERE
3. UNUSUAL BLEEDING OR DISCHARGE
4. ANY CHANGE IN A WART OR MOLE
5. PERSISTENT INDIGESTION OR DIFFICULTY IN SWALLOWING
6. PERSISTENT HOARSENESS OR COUGH
7. ANY CHANGE IN NORMAL BOWEL HABITS

None is a *sure* sign of cancer, but only a doctor can tell.

AMERICAN CANCER SOCIETY

FOR *MORE* LIFE-SAVING FACTS ABOUT CANCER CALL THE AMERICAN CANCER SOCIETY OR WRITE TO "CANCER" IN CARE OF YOUR LOCAL POST OFFICE.

Receives New Research Post

James A. Merrill

James A. Merrill, formerly manager of the Technical Division of Goodyear Atomic Corp., Portsmouth, Ohio, has been transferred to the parent Goodyear Tire & Rubber Co., Akron, Ohio, as associate director of research and development. Mr. Merrill joined Goodyear in 1930, following his graduation from Massachusetts Institute of Technology, where he received a B.S. degree in chemical engineering. In Goodyear's Research Division, he worked in applied physical chemistry, compounding research and self-sealing gas tank research. For his work in fuel tank design and construction, a Presidential citation was awarded to him at the suggestion of the Air Force. Before his assignment with Goodyear Atomic, Mr. Merrill was assistant manager of research in physical mechanisms and processes. He was one of 27 key men selected to help organize Goodyear Atomic Corp. when the parent company was named in 1952 to operate the AEC's Southern Ohio gaseous diffusion plant. He began as manager of the Laboratory Division and was later named to head the Technical Division. Mr. Merrill is a member of the American Chemical Society, the American Institute of Chemical Engineers and the American Association for the Advancement of Science.

Hill Joins Mohawk Rubber

Robert M. Hill has been named manager of tire compounding for the Mohawk Rubber Co., Akron, Ohio. Before he joined Mohawk, Mr. Hill was associated with various divisions of the Armstrong Rubber Co., where he served as superintendent of the Compounding Division of that company's Des Moines, Iowa, plant, and worked in research and development at the Westhaven, Conn., plant. He was also associated with Firestone in research compounding and the Celanese Corp. as a control chemist. Mr. Hill received a bachelor's degree in education at Western State College in Illinois and a master's degree in science from Texas A. & M.

Take a long time for this copy of RUBBER AGE to reach your desk? Order a personal subscription today!

Report On Elastomers Tests

A report, released through the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., describes investigations conducted by the Army Ordnance Corps which led to recommended revisions of an ASTM test of impact speed-brittle temperature relationships for elastomers. Entitled *Effect of Impact Speed on the Brittle Temperature of Elastomers*, Rock Island Arsenal Laboratory, Ordnance Corps, U. S. Army, PB 121502 gives details of an experiment in which a motor driven tester described in the ASTM test D746-54T was used to determine brittle temperatures of compounds prepared from GR-I, polychloroprene, GR-S and nitrile polymers at impact speeds ranging from 0.7 to 33.1 feet per second. Impact speed-brittle temperature relationships were compared to stiffness data obtained with the Gehman (ASTM D1053-54T) apparatus. The brittle temperature-impact speed relationship was shown to be non-linear. Spread between the temperatures of no failure and of complete failure at speeds from 1 to 33 fps averaged about 10°F. for the four stocks, a range applicable to a majority of rubber compounds. Among recommendations made was a change in impact speed in ASTM D746-54T from 6.5 fps to 12 fps, plus or minus 0.5 fps, for improved reproducibility of brittle temperatures. Also proposed was the definition of the brittle temperature of elastomers as the coldest temperature at which no failure occurs, rather than the temperature at which 50 per cent failure takes place. The 20 page report, published in February, 1956, is priced at 50 cents.

FINANCIAL BRIEFS

Archibald G. Bush, a director of the Minnesota Mining & Manufacturing Co., has made gifts of 7,115 common shares and sold 4,400 shares, reducing his direct holdings to 666,907 shares.

Edward Lamb Enterprises, Inc., direct and indirect beneficial owner of more than 10% of the common stock of the Seiberling Rubber Co., have purchased 3,462 common shares. Direct holdings now amount to 66,399 shares and indirect holdings to 4,260 shares.

Eugene A. Roberts, vice-president of the Armstrong Rubber Co., has bought 1,000 Class A common shares, increasing his direct ownership to 2,067 shares. James A. Walsh, Jr., vice-president, has made gifts of 800 shares, decreasing his direct ownership to 63,008 shares.

Alfred R. Bachrach, director of the National Rubber Machinery Co., reports the sale of 7,300 common shares by the Elba Capital Corp., eliminating its entire holdings of this issue. Mr. Bachrach is chairman of Elba.

Pyramid Rubber Co. has bought 2,900 common shares of A.G. Spalding & Bros., Inc., increasing its direct holdings to 118,011 shares.

Moore Laboratories Formed

Clarence B. Moore

Clarence B. Moore, who has been in the fields of rubber technology and chemical sales for 35 years, has purchased from Herron Bros. & Meyer, Inc., their laboratory at Hamilton Square, N. J. The newly acquired facility will be known as the Moore Laboratories and will be operated as a consulting agency offering its services to all rubber manufacturers. Rubber chemicals will also be evaluated for chemical manufacture.

Materials Handling Show Planned

The 7th National Materials Handling Exposition, to be held at Convention Hall, Philadelphia, Penna., from April 29 to May 3, will exhibit equipment valued at more than $5,000,000, according to an announcement by the exposition management, Clapp & Poliak, Inc., New York, N. Y. Some 6,000 pieces of equipment and accessories, of more than 100 basic types will be exhibited at the showing, which is said to be 15 per cent larger than the previous exposition, held in Chicago two years ago. Theme of the 1957 show will be "Materials Handling—Key to Automation". Concurrently with the show, April 30 to May 2, the American Materials Handling Society will conduct a conference to be addressed by 32 speakers. On May 1, the society will hold its annual banquet at the Bellevue-Stratford Hotel, where annual awards and honors will be presented.

General Latex Names Jefferson

General Latex and Chemical Corp., Cambridge, Mass., has announced the appointment of William H. Jefferson as general manager of the General Latex and Chemical Corp. (of Ohio) at Ashland, Ohio. Mr. Jefferson has served as sales manager for the midwest territory and will continue in that position in addition to his other duties.

Dayton Develops New Type Foam

Dayton Rubber Co., Dayton, Ohio, has developed an improved manufacturing process to produce a foam slab material that can be split to a thickness of ⅛-inch. The material can be used for shoe inner soles, ironing board covers, powder puffs, quilts and other items that require a foam with fine cell structure.

Articles on Natural Rubber

In the current issue of *Rubber Developments*, a quarterly devoted to the latest advances in natural rubber, a series of articles appear which discuss the work of natural rubber scientists in Southeast Asian and European laboratories toward the improvement of natural rubber. An article entitled "Technically Classified Rubber and Behavior Uniformity," relates the results of a method, established in 1949, of classifying rubber according to its behavior during vulcanization. Another article on "Superior Processing Rubber and Ease of Conversion," speaks of a recently developed processing method which permits ease of conversion and which promises to reduce scrap from complicated extrusions and to extend the range of articles that can be made with rubber. Recent research efforts to discover a superior method of dirt determination are explored in "Dirt Determination, Long Lasting Marking, Inks and Non-Gritting Powders."

A fourth article, "Agricultural Experiments, Specially Purified Rubber and Work with Sulfuric Acid," discusses progress made in studies to see whether different clones or agricultural practices and conditions may yield rubbers of varying quality. "Latex Quality," reports on methods of detecting incipient decomposition by the determination of volatile acids which have been helpful in ensuring early and proper preservation. A free copy of *Rubber Developments* is available through the Natural Rubber Bureau, 1631 K Street, N.W., Washington 6, D. C.

Nolo Contendere Plea Filed

Five of the six leading firms indicted last June for alleged monopolistic practices have filed motions to change their pleas from innocent to nolo contendere. Dayton Rubber Co., Dayton, Ohio, was the only firm that did not file a motion to change its plea. If granted by the federal court, the altered pleas would mean that the firms would not contest the government's charge that they violated the Sherman Anti-Trust Act. The technical plea, amounting to "no contest," does not involve an admission of guilt. The firms involved are Gates Rubber Co., Dayton Rubber Co., Goodyear Tire & Rubber Co., Boston Woven Hose & Rubber Co., U. S. Rubber Co. and the B. F. Goodrich Co. The six firms are accused of conspiracy to fix prices, discount rates and other terms of the sale of industrial rubber "V" belts. If convicted, they face a possible fine of $50,000 each. Those motions and all others in the case were to have been heard on February 8.

Coleman Named Sales Manager

H. E. Coleman has been appointed sales manager of the Polychemicals Division of West Virginia Pulp and Paper Co., New York, N. Y. Mr. Coleman has ten years of broad market experience in the chemical field as a sales representative, assistant sales manager and most recently, as general sales manager of the Kelco Co. During World War II, he served as captain in the U. S. Marine Corp. Mr. Coleman was educated at the U. S. Naval Academy.

Vila Elected Vice-President

George R. Vila

George R. Vila, formerly assistant general manager of the Naugatuck Chemical Division of the U. S. Rubber Co., New York, N. Y., has been elected a vice-president of the parent company and appointed general manager of the division. Mr. Vila succeeds John E. Caskey, who has retired after 42 years with the company. Mr. Vila received a bachelor's degree in chemistry from Wesleyan University and a master's degree in chemical engineering from Massachusetts Institute of Technology. He joined the company in 1936 and was appointed a sales representative in the Rubber Chemicals Department. In 1942, he was assigned to the Research and Development Department and a year later became synthetic rubber research manager for the division. Following World War II, he was part of a government committee that studied synthetic rubber production methods in Germany and on his return, he initiated research that led to the development of "cold" synthetic rubber. In 1945, Mr. Vila was named assistant manager of research and development for the division and in 1949, he became manager of general product sales. He was appointed general sales manager in 1952 and the following year, he was made assistant general manager. Mr. Vila is a director of the National Agricultural Chemical Association, a member of the American Chemical Society, the Chemist's Club and the Society of the Plastics Industry. He is also active on several committees of the Manufacturing Chemists Association.

Offers New Primary Plasticizer

Industrial Chemicals Division of the Pittsburgh Coke & Chemical Co., Pittsburgh, Penna., has developed a new primary plasticizer called "PX-313." The plasticizer is a modified alkyl phthalate that imparts low temperature flexibility in vinyls equivalent to that obtained from normal octyl-normal decyl phthalates, but its cost is appreciably lower, the company says. PX-313 combines low temperature flexibility and low volatility with excellent processing characteristics and may be used in high quality coated fabrics, sheeting and film. The company also believes that the material is excellent for use in plastisols because of its good initial viscosity and prolonged shelf life.

Goodyear Education Program

Goodyear Tire & Rubber Co., Akron, Ohio, will continue through 1957 a four-point aid to education program announced in 1956 by P. W. Litchfield, chairman of the board, which was designed to stimulate interest and encourage greater participation in scientific careers. The program, believed to be the first of its type sponsored by a rubber company, will continue to: provide for advanced technical training for full-time public and parochial high school mathematics and science teachers in Summit County; give financial aid to further the education of Goodyear personnel engaged in engineering and technical work; increase the enrollment facilities of the Goodyear Apprentice School and the company sponsored Engineering Squadron Training program; provide for an annual joint dinner meeting of Goodyear technical personnel and approximately 300 junior and senior high school mathematics and science teachers from public and parochial schools in Summit County to discuss technical subjects of current interest. As an additional step in the program to increase interest in the engineering and technical fields, Goodyear has instituted a plan designed to aid technical and non-technical college graduates, engaged in full-time engineering and technical jobs for the company, in communities where Goodyear domestic plants are located.

Goodrich Education Plan

B. F. Goodrich Co., Akron, Ohio, has announced that a total of 121 colleges and universities in 33 states have benefited from the gift matching and tuition sharing grants in the company's Aid-to-Higher-Education Program since the plan was announced last April. A total of 490 Goodrich employees have participated in one or both types of grants. During the first semester of the 1956-57 school year, 309 employees participated in the tuition sharing program, with 223 of the students attending classes in Ohio. Cost of education grants equal to 50 per cent of tuition and laboratory fees are also made to the colleges and universities where the employees study. Besides tuition sharing and gift matching, the Aid-to-Higher-Education Program also includes four-year scholarships to qualifying high school graduates selected by the National Merit Scholarship Corp., the making of grants to colleges and universities for designated research and development, and the employment of outstanding college and university teaching and research talent for consultation on company projects.

Appointed Manufacturing Manager

Linear, Inc., Philadelphia, Penna., has appointed Willard T. Davis to succeed Stuart J. Northrop as manufacturing manager. Prior to his appointment by Linear, Mr. Davis was with the Sun Rubber Co., Barberton, Ohio. He was formerly associated with the Goodyear Tire and Rubber Co. and General Aniline Corp. Mr. Northrop has joined the newly formed Atomic Energy Division of Westinghouse Electric Co.

MCA Offers Teaching Award

Manufacturing Chemists' Association has announced that six medals and awards will be presented this June for outstanding chemistry instruction on the undergraduate level in American colleges and universities. Cash awards of $1,000 each as well as medals and citations will be granted to winners, who will be chosen on a nationwide basis by a board of judges comprising men from various universities, associations and industries. To be eligible for nomination, a teacher must have taught chemistry on an undergraduate level for at least 15 years, with a minimum of five years at the institution from which he is named. Professors emeritus are among those eligible.

Judges will consider evidence that the nominee has been personally responsible over a period of years for holding and inspiring the interest of students in the field of chemistry on the basis of such supporting information as: (1) the percentage of the student body electing one or more courses in chemistry; (2) the percentage of the graduating class electing majors in the field of chemistry, and (3) the percentage of graduates selecting postgraduate courses related to chemistry. Nomination should be made by presidents of colleges or universities, offering four-year bachelor degrees, from February 1 to April 15. Winners will be announced about May 1 and will receive their awards at the annual meeting of the MCA at White Sulphur Springs, West Va., on June 6. The Awards Program is one of the features of the over-all education activity of the MCA.

Elected REA Managing Director

Joseph A. Andreoli, vice-president of General Tire & Rubber Co., Akron, Ohio, has been elected managing director of the Rubber Export Association (REA), succeeding S. J. Broers, president of Firestone International. Other officers elected at the association's annual meeting are: deputy managing director, Oliver C. Moles (General Tire); secretary, Ed Foote (Goodyear); treasurer, William Kemerer (Firestone). Mr. Andreoli, a rubber industry executive since 1918, joined General Tire in 1930 as executive vice-president of the firm's export company. Last year, he was named a vice-president of General Tire. Mr. Andreoli is a director of the International Road Federation.

Buying Tile Equipment

Johnson Rubber Co., Middlefield, Ohio, has announced plans to purchase the rubber and plastic floor tile manufacturing equipment and inventories now owned by Hewitt-Robins, Inc., at its plant in Fremont, Ohio. Terms of the sale, which will be completed on April 5, were not disclosed. Hewitt-Robins said the sale will release the additional floor space at the Fremont plant which is needed to expand production of other items. Hewitt-Robins will continue to manufacture and sell sponge rubber and plastic foam carpet cushioning products.

ADL Sets English Research Unit

Arthur D. Little Research Institute, a new type of contract research organization, has been established in Great Britain to undertake fundamental scientific investigations for industrial sponsors. Located in the laboratories formerly occupied by the Institute of Seaweed Research at Inveresk near Edinburgh, the organization is sponsored by Arthur D. Little, Inc., industrial research company of Cambridge, Mass., and several prominent individuals in the United Kingdom. Cost of establishment and initial support will be borne by American funds but future research projects at the Institute will be open to British and continental sponsorship on comparable terms. The Institute will be primarily concerned with work for industrial sponsors, although current plans include some work on seaweed. Operations of the Institute will be directed by Dr. F. N. Woodward, formerly director of the Institute of Seaweed Research. Relations between the Institute and ADL will be coordinated from Cambridge, Mass., by Dr. L. W. Bass, who has in previous years served as director of research at the Borden Co., and in several other executive capacities.

N.R.C. Metals Corp. Formed

National Research Corp. and Columbia-Southern Chemical Corp. have become associated as equal stockholders in N.R.C. Metals Corp., formerly a wholly-owned subsidiary of National Research. The company will produce and sell zirconium and hafnium metals to the Atomic Energy Commission and to other customers. N.R.C. Metals Corp. currently has under construction at Santa Rosa County, near Pensacola, Florida, a plant designed for the production of zirconium and hafnium. The new plant is scheduled for production toward the end of 1957. The firm has a purchase agreement with the Atomic Energy Commission for 3,500,000 pounds of zirconium and hafnium metals and will supply other industries when the new operation reaches capacity production.

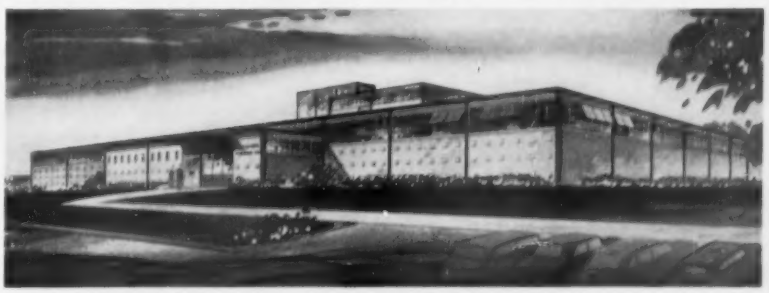
Dow Licenses Esso Research

Esso Research and Engineering Co. has signed a license agreement to use Type B catalyst and process, developed by Dow Chemical Co., Midland, Mich., for making butadiene. The license may be made available to affiliates of Esso Research worldwide. Esso Petroleum, Ltd., a British affiliate of Esso Research, plans to use the process at its new butadiene manufacturing facilities in Fawley, England, which are expected to be in operation in 1958. The Dow process and catalyst, developed jointly by Polymer Corp. and Dow, have been in the commercial development stage for several years at the Polymer Corp. Dow Type B catalyst is a calcium nickel phosphate material. Its use in butadiene production represents approximately a 20 per cent increase in production efficiency over other catalysts now in use, Dow production studies have shown. Dow also believes that considerable savings in capital and plant equipment will result from its use. With modification of equipment, the catalyst can be used in butadiene manufacturing plants now in operation. Dow is presently building a plant in Ludington, Mich., to produce this catalyst. In addition, a semi-plant, recently placed on stream, has been built by the company at Freeport, Texas, to continue research and development on the process which converts butylene petroleum fractions to butadiene by dehydrogenation.

Buys Testing Machine Division

Testing Machines Inc., New York, N. Y., has acquired the Testing Machine Division of National Forge & Ordnance Co., Irvine, Penna., as part of the company's scheduled program to round out its line of testing equipment. This purchase increased the firm's line of compression testers for flat, ring and Concora Line Test and large testers for 5,000 and 10,000 pound compression of full containers. Testing Machines will make available both parts and service to manufacturers formerly served by National Forge.

PEQUANOC RUBBER CONSTRUCTING NEW COMPOUNDING PLANT IN GEORGIA



Pequanoc Rubber Co. of Butler, N. J., is now constructing a new rubber compounding plant at Tallapoosa, Ga., at an approximate cost of $500,000. Scheduled for completion in June, the plant will initially employ about 30 persons. The 25,000 square foot plant is located on a 100-acre site which allows ample room for future expansion. S. Stanley Rogers, formerly chief chemist at Pequanoc Rubber, has been named superintendent of the new plant. Mr. Rogers was graduated from Rensselaer Polytechnic Institute in 1939 and served with the U. S. Army during World War II. After the war, he joined the R. T. Vanderbilt Co. Mr. Rogers joined the Pequanoc Rubber organization in 1954.

West Coast News

The technical portion of the February 5th meeting of the Los Angeles Rubber Group held at the Biltmore Hotel in Los Angeles, Calif., featured an address by J. H. Lorenz, director of technical service for silicone rubber at the Silicones Division of the Union Carbide and Carbon Corp. Mr. Lorenz spoke on "Progress in the New Properties Available in Silicone Rubber."

The speaker observed that the technology of silicone elastomers has improved rapidly in the past few years. He noted that the vinyl-containing gums allow the use of new fillers, including carbon blacks, and the use of new curing agents. Curing mechanisms suggest a trimethylene bridge in the cross-link. New properties of compounds include 600°F. service, steam service, and resistance to reversion.

Mr. Lorenz declared that silicone rubber compounds can now be used in many new applications, including those in which metal-to-rubber or cloth-to-rubber bonds are necessary. Thick section parts are now easily fabricated and cured. Newer developments are under way to further extend the utility of silicone elastomers, he stated.

The non-technical portion of the meeting featured a program of entertainment by Edwin L. Baron, hypnotist. The technical portion of the March 5th meeting, scheduled to have been held at the Biltmore Hotel, was to have featured an address by John M. Ball (Midwest Rubber Reclaiming) on "Compounding and New Developments in Reclaimed Rubber." A report on this meeting will appear in a future issue of this journal.

Polyfoam Products Co. has announced a move to new and larger quarters at 766 East 12th St., Los Angeles 21, Calif. The company is expanding its facilities and adding new equipment to handle increased demand for its polyurethane products.

Pacific Moulded Products Co. is contemplating the construction of additional laboratory facilities which will double the present area and permit increased developmental and control work.

Naugatuck Chemical Division, U. S. Rubber Co., has announced the appointment of T. W. Brasfield as district manager in the Los Angeles district.

A. Schulman, Inc., has established a West Coast office at 1127 Wilshire Boulevard, Los Angeles. The new office is under the supervision of Frank M. Francis, vice-president in charge of the West Coast Division.

Copies of the TLARGI 1957 Yearbook, recently published, may be obtained by writing to Chairman, Yearbook Committee, Los Angeles Rubber Group, Statler Hotel, Los Angeles, Calif.

Walter Westman has begun the production of molded specialties for the oilfield and aircraft industries. The new company is operating in Compton, Calif., under the name of Westman Rubber Works.

Industrial Rubber Cement Co. of Hawthorne Calif., has broken ground for a new extension to their office building. It is also reported that the company has acquired a new 40-inch mill.

Lee-Tex Rubber Products Corp. of Gardena, Calif., has been merged with Aubin Industries, manufacturers of plastic toys. Floyd Rexford has been named plant manager at Lee-Tex succeeding Warren Durkin.

R. D. Abbott Co., Inc., has been named West Coast representative to the rubber industry by Universal Oil Products Co.

Leonard K. Firestone, president of the Firestone Tire & Rubber Co. of California, has been appointed as director of the Los Angeles branch of the Federal Reserve Bank of San Francisco. His appointment is for the unexpired portion of a term ending December 31, 1958.

Ed Wray has resigned as chief chemist at the Orange, Calif., plant of the Anaconda Wire & Cable Co., to accept a similar post with the Sequoia Processing Co. of Redwood City, Calif.

Bob Kavish has resigned his post with the American Mineral Spirits Co. to join the General Electric Co.

DuPont Plans New Titanium Plant

E. I. du Pont de Nemours & Co., Inc., plans the construction of its third plant for the manufacture of titanium dioxide on a 1500-acre site near Johnsonville, Tenn. The plant will have a capacity of 125 tons of titanium dioxide a day and will, initially, employ a total of 400 persons in its operating force. Actual construction is expected to begin soon with completion scheduled for early 1959. The facility will be operated by the Pigments Department, which is also expanding its Baltimore, Md. and Edge Moor, Del., facilities to meet the rising demand for the pigment. The Johnsonville plant will employ a recently developed chemical process for the manufacture of titanium dioxide, known as the chloride process, utilizing a raw material called Ilmenite, a black sand with a high titanium content. The Pigments Department has also announced the construction of what is said to be the first full-scale plant for manufacturing hyper-pure silicon near Brevard, N. C.

What's going on abroad? Read "Overseas" by Reuter's. (See page 1068).

Flow Control Agent Developed

"Thixcin E", a new thixotropic agent, has been developed by the Baker Castor Oil Co., New York, N. Y., to inhibit crawling, sagging, draining and pigment settling in polyester resins. The additive is characterized by easy stir-in with maximum results attained at temperatures in the area of 90° to 110°F. As little as 0.2 per cent of Thixcin E imparts a highly thixotropic body to polyesters, the company says. Viscosity effects in polyesters thickened by Thixcin E are a function of degree of concentration and stir-in temperature. Baker Application Newsletter No. 35, obtainable on request to the company, gives full information on the effects of the material, storage and processing of polyesters containing Thixcin E.

Buys Two West Coast Firms

Parker Appliance Co., Cleveland, Ohio, has announced the purchase of two West Coast concerns, Franklin C. Wolfe Co., Inc., Culver City, Calif., and Mathewson Corp., Los Angeles, Calif. The two acquisitions involve a total of 45,000 shares of Parker Appliance common stock and $180,000 in cash, a company spokesman said. The two newly acquired concerns together employ over 200 persons and do an annual business in excess of $3 million, largely in the military field. It is reported that Mathewson Corp. will be moved from Los Angeles to a new plant under construction next to the Franklin C. Wolfe plant in Culver City. Both concerns will be operated as the Franklin C. Wolfe Co., division of Parker Appliance Co.

Campaigne Joins Cabot

Godfrey L. Cabot, Inc., Boston, Mass., has announced the appointment of William E. Campaigne to its Technical Department as technical representative. Mr. Campaigne's headquarters will be located in Akron, Ohio. A native of Minnesota, Mr. Campaigne received a bachelor of chemical engineering degree in 1937 from the University of Minnesota. Before he joined Godfrey L. Cabot, Inc., he was with the Goodyear Tire & Rubber Co., Akron, Ohio, for 14 years. During World War II, Mr. Campaigne obtained leave from Goodyear to serve for two years in the U. S. Navy in the South Pacific. Mr. Campaigne is a member of the American Chemical Society and the Professional Engineers organization in Ohio.

Detroit Group Hears Sweitzer

The Detroit Rubber and Plastics Group held its first 1957 meeting on February 1, at the Detroit-Leland Hotel in Detroit, Mich., with approximately 200 members and guests in attendance. The technical portion of the meeting featured an address by Dr. Carl W. Sweitzer, director of research of the Columbian Carbon Co., who spoke on "Carbon Black Polymer Interactions." The after dinner speaker was Dr. L. Heard, research chemist for the Standard Oil Co. of Indiana. Dr. Heard entertained the group with a lecture-demonstration of "Fire Magic".

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Canadian News

Preparations are underway for an orderly shutdown at Polymer Corp., Sarnia, Ont., in case of strike action which has been threatened by Local 16-14, Oil, Chemical and Atomic Workers. The union and Polymer management have been holding meetings to formulate plans to insure that, if a strike does hit the Crown-owned company, the plant would be closed and the danger of fire or explosion reduced to a minimum. The plant supplies steam, generated in large quantities in the polymerizing process, to four neighboring companies, Dow Chemical, Imperial Oil, Fiberglas and Cabot Carbon.

Officials fear that the cessation of deliveries of this steam will seriously curtail operations at the four companies and at Ontario Hydro, which uses Polymer's surplus power. The union is asking for a 20 per cent wage increase across the board, fringe benefits and contract changes for one year. The company has offered 8.5 per cent increase at the date of signing, three per cent for each of the next two years, and a cost of living escalator clause, all on a three-year contract. Conciliation majority and minority reports have been rejected. They include 12½ per cent increase in pay.

Canadian Industries, Ltd., has authorized 17 fellowships totalling $32,500 for the academic year starting in September, 1957. The fellowships will be awarded to qualifying students for postgraduate research in chemistry, agricultural chemistry and chemical engineering in universities across the country. Other fellowships will be awarded to students studying wildlife management. The company, which began its scholarship program 17 years ago, offers two categories of chemistry fellowships. The first, valued at $2,000, is for research by qualified students seeking a doctorate degree and the second, valued at $1,500, for students seeking masters' degrees. Wildlife fellowships are each valued at $1,500 with possible additional grants of $1,000 for summer work.

A fire causing damage estimated at $1,000,000 broke out at the plant and buildings of the National Rubber Co., Toronto, Canada, recently. The fire, which gutted two buildings and badly damaged two others, was the second three-alarm blaze in three years at the company. On January 25, 1954, $500,000 damage was done to stock and buildings in a fire that burned for two days. The buildings destroyed in this last fire were those built to replace units gutted in 1954. Cause of the fire is unknown.

J. G. Edmiston has been appointed product sales manager for rubber chemicals for Monsanto Canada, Ltd., Montreal, Quebec. A specialist in rubber chemicals with broad sales experience in this field, Mr. Edmiston will be in charge of the sale of a wide variety of accelerators, antioxidants and other rubber chemicals. Associated with Monsanto since 1954, he was previously employed in both technical and purchasing capacities.

Drew Brown, Ltd. has been appointed distributor in Canada of most of the organic chemical products of the Dewey and Almy Chemical Co. of Canada, Ltd. According to Dewey and Almy officials, Drew Brown will service all of Canada except British Columbia, which will continue to be served by B. B. Smith & Co., Seattle. Drew Brown offices in Montreal and Toronto will distribute Dewey and Almy's Darex vinyl acetate polymers, Everflex vinyl acetate copolymer emulsions and Darex butadiene-styrene copolymer latices and resins.

In a letter to shareholders, Goodyear Tire & Rubber Co. of Canada reported that the company's sales and earnings reached a record high in 1956. Consolidated net income of $6,222,804, which is equal to $23.06 a common share, was up 42.1 per cent from $4,379,946, or $15.96 a share, in 1955. Capital expenditures totaled $2,924,669. Working capital rose by $4,015,645 to $26,428,666 at year-end. Ratio of current assets to current liabilities was 4:1 compared with 3.8:1 a year earlier.

B. F. Goodrich Canada Ltd. has appointed P. G. Cockburn to the new position of manager of sales planning in the Tire Replacement Division, with headquarters at the company's Kitchener, Ont. head office. Mr. Cockburn, a native of Ottawa, received his elementary and secondary education in that city. Associated with Goodrich since 1938, he was formerly district manager of the Tire Division in Vancouver. In another appointment, William C. Nickell was named manager of methods administration for the company. A graduate of the Lake Placid Works Simplification School, Mr. Nickell has specialized in systems and procedures work, clerical work simplification and clerical work measurement. He is the author of a number of technical articles on these subjects.

Gordon C. Forbes has been appointed assistant-secretary of Dunlop Canada, Ltd. Mr. Forbes will retain his responsibility as general credit supervisor.

Completes Di-Isobutylene Facility

Texas Co., New York, N. Y., has announced the completion of facilities for the production of di-isobutylene in Port Arthur, Texas. Initial capacity is 8,000,000 pounds annually, with provision for expansion as requirements increase. Completion of the di-isobutylene facilities mark another step in Texaco's current petrochemicals expansion, which includes construction of a lubricating oil additive plant in Port Arthur and an ammonia plant in Lockport, Ill.

Shuri Joins Sun Rubber

Joseph F. Shuri

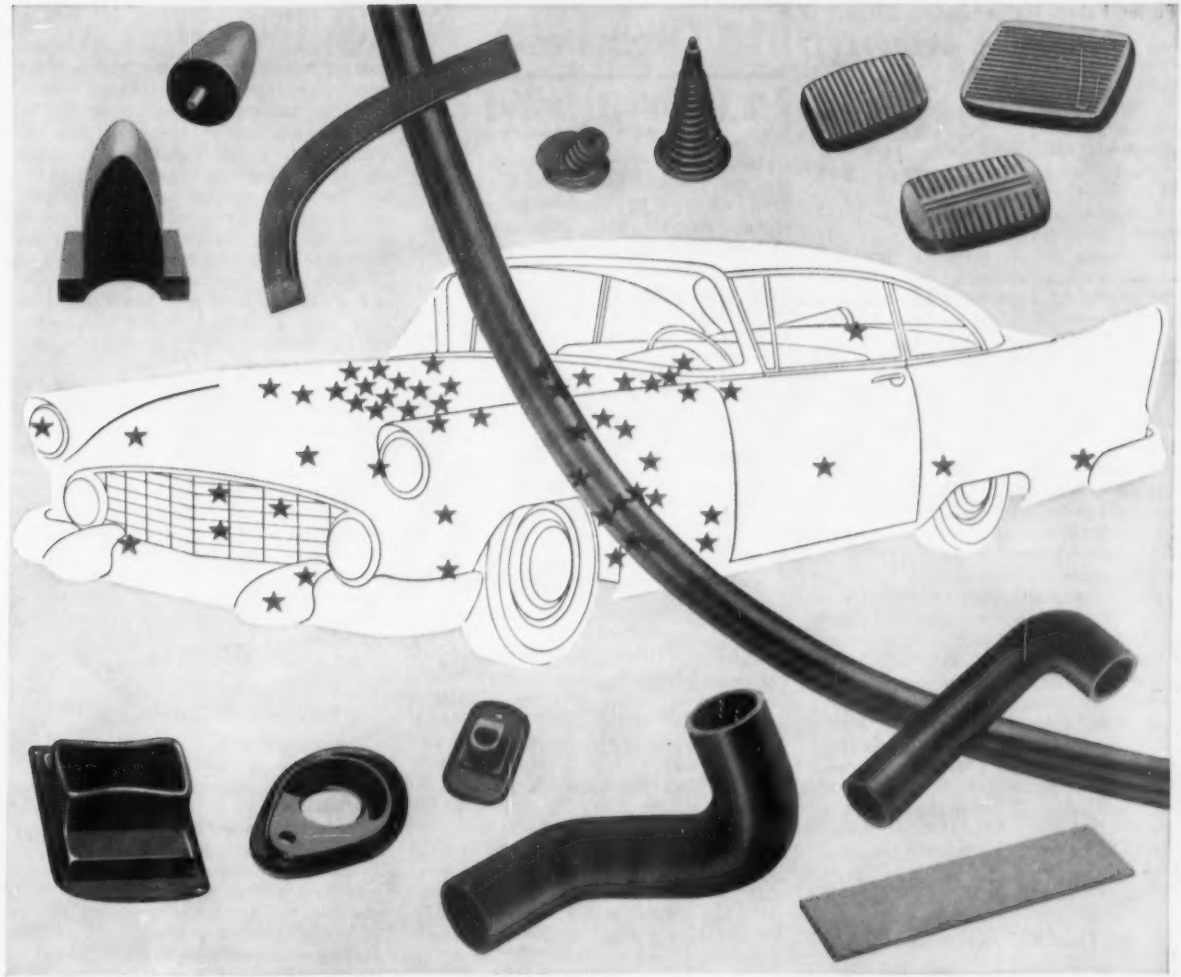
Joseph F. Shuri, formerly division manager of molded rubber goods and consulting engineer at the Ohio Rubber Co., Willoughby, Ohio, has been named factory superintendent of rubber production by the Sun Rubber Co., Barberton, Ohio. The company has also announced the promotion of Wendell H. Stepp from general foreman of vinyl castings to factory superintendent for vinyl products and athletic goods, and the appointment of Elmer Davies as general foreman of vinyl castings. Mr. Shuri, a graduate of Carnegie Tech, is past president of the Cleveland Chapter of the American Institute of Industrial Engineers and a vice-president of the national organization.

Offers RP and VP Gravure Inks

Claremont Pigment Dispersion Corp., Long Island, N. Y., has announced the development of the "RP" series Gravure Inks, for printing on treated polyethylene and the "VC" series for vinyl in a complete range of colors including tarnish resistant gold and copper. According to the company, technical qualities of the inks now permit high speed printing at 200 to 300 feet per minute; scotch tape tests of Claremont Gravure prints show excellent adhesion and they pass through embossing or vacuum forming operations at elevated temperatures without picking off. Expanded production facilities and greatly increased rate of output permit Claremont to offer further reductions in quotations on these gravure ink lines, the company says.

Reorganizes Unit Acitivities

In a reorganizational move, International Telephone and Telegraph Corp., New York, N. Y., has transferred wire and cable manufacturing activities previously conducted by Federal Telephone to Royal Electric Corp., I. T. & T. subsidiary in Pawtucket, R. I. The reorganization was undertaken to establish clean-cut profit responsibility for each of the firm's principal product lines and its related market area and to eliminate overlapping of sales and production efforts, a company spokesman said.



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Forms Fabric Rainwear Committee

An Industry Advisory Committee on Coated Fabric Rainwear has been established by the Quartermaster General of the U. S. Army to advise the Quartermaster Corps on problems related to specification requirements for coated fabric rainwear. The first meeting of the committee was held on February 20 with J. L. Lewis, of the Chemicals and Plastics Division, Quartermaster Research and Development Command, Natick, Mass., presiding. Industry representatives, composed of manufacturers of coated fabric rainwear and suppliers of seam sealants to the trade, were requested to offer their advice and recommendations on: (1) The ability of the rainwear industry to produce rainwear complying with the proposed specification for the Raincoat, Man's, Lightweight, Taupe 179; (2) The adequacy of the proposed specification for Raincoat, Man's, Lightweight, Taupe 179, and (3) Suggestions for changing the proposed specification to simplify production and procurement of the raincoat or show savings in the production of the item.

Many constructive recommendations, now under consideration for application, were contributed by the industry representatives, particularly in simplification of production, and reduction of costs of the raincoat. Members of the new committee include: Cecil Rose (Neptune Garment), Austin Cable (Cable Raincoat), L. J. Roberts (Crawford Mfg.), Otto K. Kunalte (Mansbrooke Rainwear), Daniel Doherty (Archer Rubber), Maurice Blauer (Blauer Mfg.), Joseph Sidran (Sidran Sportswear), and Frank Glavin, (Angier Products).

Stein Hall Elects Two

Stein, Hall & Co., Inc., New York, N. Y., has announced the election of S. Crawford Bonow as a vice-president, and the election of Joseph C. Blauvelt, vice-president, to the board of directors. Mr. Bonow, in addition to his new position as vice-president, is also manager of the firm's Manufacturing Division and a vice-president of both the Stein-Davies Co. and the Eastern Maine Starch Co., subsidiaries. He has been associated with the Stein Hall organization since 1946. Mr. Blauvelt joined the company in 1919, holding a number of important posts. He was elected an assistant vice-president in 1941 and in 1952 was elected vice-president.

Eagle Rubber Buys Tucker-Brame

Eagle Rubber Co., Ashville, Ohio, has purchased the Tucker-Brame Athletic Manufacturing Co. of Batesville, Ohio, according to current reports. The firm plans to continue its operations in Batesville and probably will expand the plant during the next eighteen months. No changes in personnel have been announced and it is understood that the firm will continue the manufacture of football equipment.

Like to make a suggestion to the industry? Write a letter to the editor! (See page 940).

Obituaries

Marcel F. Bachner

Marcel F. Bachner, president and treasurer of the Chicago Molded Products Corp., Chicago, Ill., died on February 21. He was 65 years old. Born in Sterling, Ill., Mr. Bachner attended Austin High School in Chicago. He was associated for seven years with the Western Electric Co. before he joined his five brothers in 1919 to form the Plymouth Manufacturing Co., now known as Chicago Molded Products Corp. He had been president of the company since July 1954 and treasurer since 1943. Mr. Bachner was a member of the Oak Park Elks Club No. 1295, the Bill Sheridan Council of the Knights of Columbus and St. Luke's Holy Name Society. Surviving Mr. Bachner are his wife and two sons.

Melvin J. Napier

Melvin J. Napier, founder and secretary-treasurer of the Miami Boiler and Machine Co., Inc., died on January 1 in City Hospital, Akron, Ohio. Mr. Napier was born in Jackson, Mich., and attended school there. He was a graduate of Michigan State College and of the Massachusetts Institute of Technology. In 1922, Mr. Napier went to Akron and in 1926, he founded the Miami Boiler and Machine Co. He specialized in the creative design and manufacture of machinery and equipment for the rubber dipped goods industry. Mr. Napier was a member of Elks Lodge 363 and the University Club. He is survived by his wife and two sons.

Philip M. Wall

Philip M. Wall, associated with the Firestone Tire & Rubber Co. for many years, died on February 1 in Long Beach, Calif. He was 60 years old. At the time of his death, Mr. Wall was district manager of Firestone's brakelining department with headquarters in Redondo Beach, Calif. Mr. Wall had been associated with the company for more than 25 years. He was born in Watertown, S. D., and lived, for a time, in Cedar Rapids, Iowa. He was a veteran of both world wars. He is survived by his wife and two stepsons.

Joins American Hard Rubber

The appointment of Felix P. Juraska as controller of the American Hard Rubber Co., New York, N. Y., has been announced by V. T. Norton, president of the company. Mr. Juraska comes to American Hard Rubber from Montgomery Ward and Co., with whom he had been associated for twenty-three years and where he has most recently served as assistant controller. A Certified Public Accountant, he was educated at Northwestern University.

FTC Hearings Scheduled for May

The Federal Trade Commission has announced that hearings on the "restraint-of-trade" case against three Akron rubber companies and three oil companies will be resumed some time in May. Firestone and Shell, Goodrich and Texas, and Goodyear and Atlantic Refining are charged with restraining trade through agreements covering the sale of tires, batteries and accessories to filling station chains. Hearings have already been held in several parts of the country on the Goodrich-Texas case, and FTC attorneys still want testimony from service station operators along the eastern seaboard. FTC charges that the rubber companies paid commissions to the oil firms in return for pushing specific brands of TBA products, and an attempt is being made to show that the oil companies have such a strong hold on gas station operators that they can force them to handle recommended TBA brands. FTC says rubber firms have paid oil companies as much as $1 million a year in commissions. The tire and oil companies admit such commissions are paid, but they contend these commissions are legitimate payment for sales assistance rendered in the sale of TBA products.

Pequanoc Rubber Hit by Fire

Pequanoc Rubber Co. of Butler, N. J., whose plants was destroyed by fire on February 26, has arranged for temporary office headquarters at the plant of its parent concern, American Hard Rubber Co., at Butler. Mixing capacity has been made available to Pequanoc Rubber at the American Hard Rubber plant so that the former company will be able to take care of some of its compounding needs. In addition, Pequanoc Rubber's new mixing plant at Tallapoosa, Ga., is expected to be in operation by May 1. At this writing, Pequanoc Rubber officials have not decided what course of action to follow with reference to the Butler plant. Officials, however, have expressed the hope that the plant will be rebuilt as quickly as possible. The fire, of unknown origin, is estimated to have caused damage ranging from $2,000,000 to $3,000,000.

Diamond to Build PVC Plant

Diamond Alkali Co., Cleveland, Ohio, has announced plans for the construction of a new plant to produce 50,000,000 pounds of vinyl chloride monomer annually. In making the announcement, company officials said that the new facility will be located at Diamond's Deer Park plant at Houston, Texas. This new vinyl chloride monomer plant will be designed and engineered by Scientific Design Co., Inc., New York. Brown & Root, Inc., of Houston, construction engineers, will build the plant, which is scheduled for completion early next year. Built to meet the rapidly increasing demand for Diamond PVC resins, the new monomer plant is part of a major expansion program, which will also include construction of a plant to produce acetylene from natural gas, company officials announced.

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Overseas

by Comtel-Reuter

New Delhi—The Plantation Enquiry Commission, set up by the Indian Government, has recommended the creation of a Rubber Replanting Fund and the planting of about 120,000 acres with high yielding trees by 1965.

—•—

Tokyo—The Japan Rubber Importers Association has announced a plan to apply a new system of commercial arbitration to rubber imports from Malaya and Singapore. Under the new system, the site of commercial arbitration will be moved from Singapore to Japan. Most Singapore shippers have agreed to the plan which is to take effect in April.

—•—

Kuala Lumpur—A new wage structure plan, including a basic wage and cost of living allowance, is under consideration by the Malayan National Union of Plantation Workers. Meanwhile, the Malayan Plantation Industries Employers Association has announced the probability of a wage cut in April due to the fall in the price of rubber.

—•—

London—The retiring chairman of the Rubber Trade Association estimates that the world's rubber needs by 1965 will be 4,000,000 tons annually. In order to insure a fair share for natural rubber, he urged a vigorous replanting program in Malaya.

—•—

Bombay—In view of the general shortage of tires and tubes prevailing in the country, the Government of India has revised its import policy in respect of automobile, bicycle and motorcycle tires, tubes and flaps and solid tires.

—•—

Singapore—A U.S. trade mission due in Malaya from March 19 to April 8, hopes to "lay the foundations for increased trade." An American consulate official stated that the U.S. has no desire to promote synthetic above natural rubber, but is concerned only with getting enough rubber to meet demands.

—•—

Tokyo—A spokesman of the Japan Rubber Manufacturers Association has expressed the belief that the new natural rubber standards distributed by the United States Rubber Manufacturers Association will improve international trade in rubber.

—•—

Kuala Lumpur—The annual report of the Rubber Producers Council, issued recently, calls for the abolition of the cess imposed on rubber by the Malayan government to combat inflation. To date, the government has refused to lift or modify the levy.

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PROCEEDINGS of the Third Rubber Technology Conference

Copies of all the papers presented at the Conference held in London on June 22-25, 1954, under the auspices of the Institution of the Rubber Industry, are presented in this volume, together with the discussions on each paper. The papers are world-wide in character and represent the latest thinking in the science and general technology of rubber. This informative volume is a **must** for all who wish to keep abreast of developments in the field.

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Properties of Natural Rubber Latex

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Improved Rubbers by the Enzymatic Deproteinization of Skim Latex. *J. E. Morris.*
Stability of Ammoniated Latex and Soap-Stabilized Emulsions in the Presence of Complex Zinc Salts. *T. S. McRoberts.*
Variability of Hevea Latex. *W. L. Resing.*
Zinc Oxide Testing of Latex. *E. W. Madge, H. M. Collier,* and *J. L. M. Newnham.*
Hevea Latex: Its Structure and Viscosity. *G. Verhaar.*
Contribution to the Study of Mineral Elements in Field Latex. *E. R. Beaufils.*
Rubber Peptized on the Plantation. *G. Giger, J. Lemee* and *M. Liponski.*

Production and Evaluation of Synthetic Rubber

Cation and Anion Influence in the Alfin Reagent for the Polymerization of Butadiene. *A. A. Morton, I. Nelidow* and *E. Schoenberg.*
Evaluation of Synthetic Rubbers and Latices. *I. D. Patterson.*
Recent Studies on the Structure of Synthetic Rubber. *R. F. Dunbrook, B. L. Johnson, J. L. Binder, J. M. Willis,* and *E. L. Carr.*
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Structure and Solution Properties of High Molecular Weight Butadiene-Styrene Copolymers. *R. B. MacFarlane* and *L. A. McLeod.*
Pyridinium High Polymers—A New Class of Oil-Resistant Synthetic Rubbers. *W. B. Reynolds, J. E. Pritchard, M. H. Opheim,* and *G. Kraus.*

Chemistry of Rubber

Studies in Latex Particle Surface Reactions: Kinetics of Hydrochlorination of Unvulcanized and Vulcanized Latices. *M. Gordon* and *J. S. Taylor.*
Oxygen-Absorption Effects in Cured and Uncured Rubber. *R. L. Stafford.*
Infra-Red Spectroscopic Analysis of Elastomers. *W. H. T. Davison* and *G. R. Bates.*
Structural Characteristics of the Sulfur Linkage in Natural Rubber Vulcanizates. *L. C. Bateman, R. W. Glazebrook, C. G. Moore,* and *R. W. Saville.*
Chemical Reactions of Antioxidants Used in Vulcanized Rubber. *P. Schneider.*
Cross-Linking and Radiation Effects in Some Natural and Synthetic Rubbers. *A. Charlesby* and *D. Groves.*

Physics of Rubber

Modification of the Permeability of Natural Rubber Vulcanizates. *P. Thirion.*
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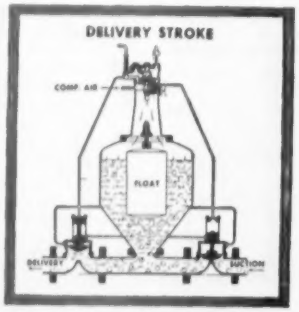

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OVERSEAS (CONT'D)

Djakarta—Russia has asked Indonesia for 3,000 tons of rubber under the trade agreement concluded between the two countries last year. An Indonesian spokesman said that although Russia is prepared to pay more than world market prices, there is still a big gap between these prices and those of the home market.

—•—

Tokyo—The Japan Rubber Manufacturers Association states that the target for Japanese exports for the 1957-58 fiscal year is $42,000,000, an increase of $8,600,000 above the calendar 1956 figure, itself an all-time record.

—•—

Singapore—A report by British experts is said to recommend that Malayan natural rubber prices be cut to 60c (Malayan) to meet competition from the synthetic market. A Singapore rubber magnate has estimated that a cut of this size would involve the loss of a monthly revenue of 20 million Malayan dollars.

—•—

Liverpool—Dockers have lifted the ban on loading of raw rubber for Russia, imposed in November as a protest against Russian action in Hungary. Soviet rubber stocks in Britain have been piling up and in Liverpool, about 4,000 to 5,000 tons were awaiting shipment at the time that the ban was lifted.

—•—

Kuala Lumpur—The Malayan Government has extended the ban on the export of a high grade type of Malayan rubber seed, classified as "T J One." Government statements say the Federation's interests must be safeguarded in view of increased exports in the last two years.

—•—

London—Carbide Industrial, Ltd., a subsidiary of the British Oxygen Co., has announced plans for the construction of an acetylene plant near Londenderry. The acetylene will be supplied to the DuPont Co. (United Kingdom), Ltd., whose project for the manufacture of neoprene at an adjacent site was recently confirmed.

—•—

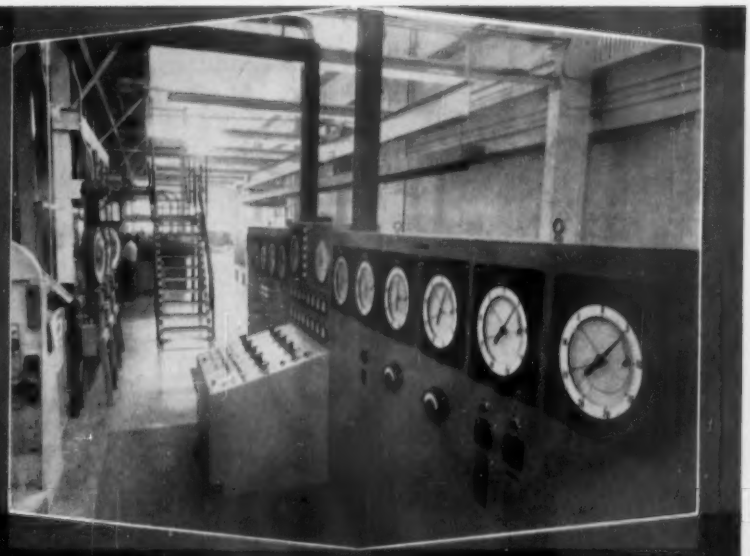
Singpore—A plan to establish a semi-official company for the production of synthetic rubber in Japan is approaching realization. The plan calls for production of about 45,000 tons of general purpose synthetic rubber by 1962.

—•—

Penang—The president of the North Malaya Asiatic Rubber Planters' Association has acknowledged that while China is a big potential customer for Malayan rubber, Malayan rubber interests should still seek to develop customers in Europe. In his opinion, the U.S. trend to synthetic is forcing a search for new natural rubber markets.

—•—

Kuala Lumpur—The Malayan rubber replanting fund is considering details of a plan to get smallholders to take part in a block replanting scheme. Under the plan, the smallholders will be able to use a replanting grant from the government to open up new land on a cooperative basis.



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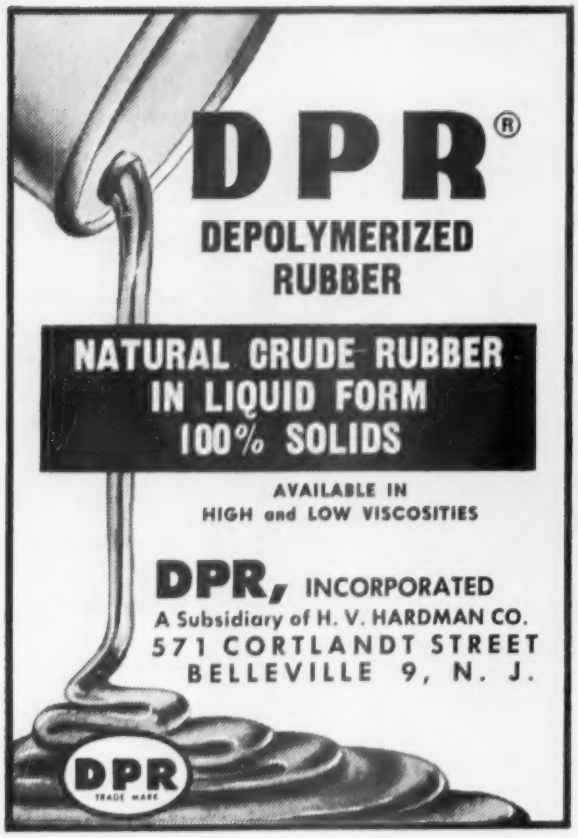

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New Goods

Safe T Mate Beach Toys

Apex Tire and Rubber Co., 505 Central Avenue, Pawtucket, R. I., has introduced new multi-colored beach, bathtub and sandbox toys based on Plioflex rubber. The rubber toys are of molded one-piece construction, which makes them virtually indestructible and safe for play, the company says. They are designed free of sharp edges, and are resistant to the effects of sun, sand, salt or

fresh water. A brilliant assortment of colors is offered. Packed in attractive counter-top packages, the toys are distributed in sets of four, known as "Safe T Mates", They include a pail and shovel set, combination rubber rake and scraper and a seagoing tug. Each piece is basically white in color, marbelized with shades of red, blue, yellow and green. Four-piece Safe T Mate sets are available in any quantity for immediate shipment. Both the Safe T Tug and Safe T Pail and Shovel sets are available as separately packaged items.

Linoleum-Type Flooring

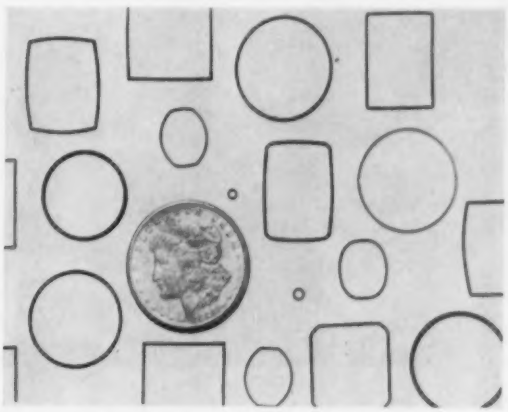
Bird and Son, Inc., East Walpole, Mass., has introduced a new linoleum-type flooring for home use, said to have a high degree of gloss, smoothness, detail and depth of color, through an unusual production process and a specially developed system of compatible coating materials. The linoleum is printed in various patterns and colors directly over a white coating of Pliolite latex, used as a printing base because of its optimum pigment binding properties, which are achieved at low cost. The entire surface is then sealed with a clear vinyl coating that provides extra wear and protection for the decorative print coat. A nine-foot rotogravure press, the only one of its kind, is used to print the four color patterns.

Neoprene Heavy Duty Suits

Standard Oiled Clothing Co., New York, N. Y., has introduced waterproof neoprene heavy duty construction worker's suits designed to provide comfort, while keeping the users warm and dry. The material resists abrasion, snags, tears, oils, grease tars and most acids. The suits, which can be changed in styling, are suitable for almost any industry that requires heavy duty clothing, the company claims.

Custom Molded Gaskets

Custom molded rubber gaskets having round cross sections as small as .020-inch, varying shapes and even mitered corners are now being produced by the Minnesota Rubber & Gasket Co., Minneapolis, Minn., with dimensional tolerances as close as plus-or-minus .001-inch. Gaskets shown below are typical of those used in sealing small units with little packing space, but similar precision



work can be done on other industrial products through a modern rubber injection molding process utilized by Minnesota Rubber. Properties of this process permit higher density of material and closer tolerances by eliminating the "flash" found in compression molding and such secondary operations as hand or machine trimming. Most natural and synthetic rubbers, including neoprene, nitrile and silicone rubber, can be molded in this manner.

New Vinylfoam Coin Pad

A new change pad, made of Vinylfoam, electronically sealed to a vinyl sheeting, is in production at the Wright Sales Co., Inc., Newark, N. J. for distribution to the liquor trade by Seagrams Distillers Co. The texture

of the foam is rough and resilient for coin control and it provides maximum ease of recovery by the customer, the company says. A fully exposed foam surface on the bottom of the pad prevents slippage.

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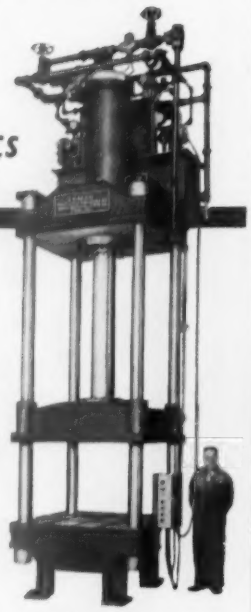

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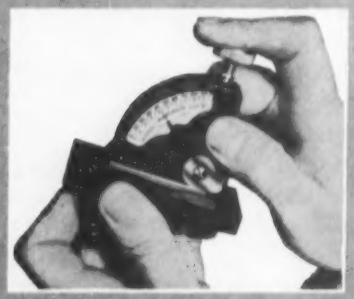

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New Spring Line of Vinyl Toys

Sun Rubber Co., Barberton, Ohio, has announced a new line of vinyl toys for the Easter Season, which consists of more than 100 items. Heading the new spring group are "Begging Rabbit," "Dippy Duckling" and "Donald Duck," shown below. The Begging Rabbit, which squeaks and whistles when squeezed, is flesh

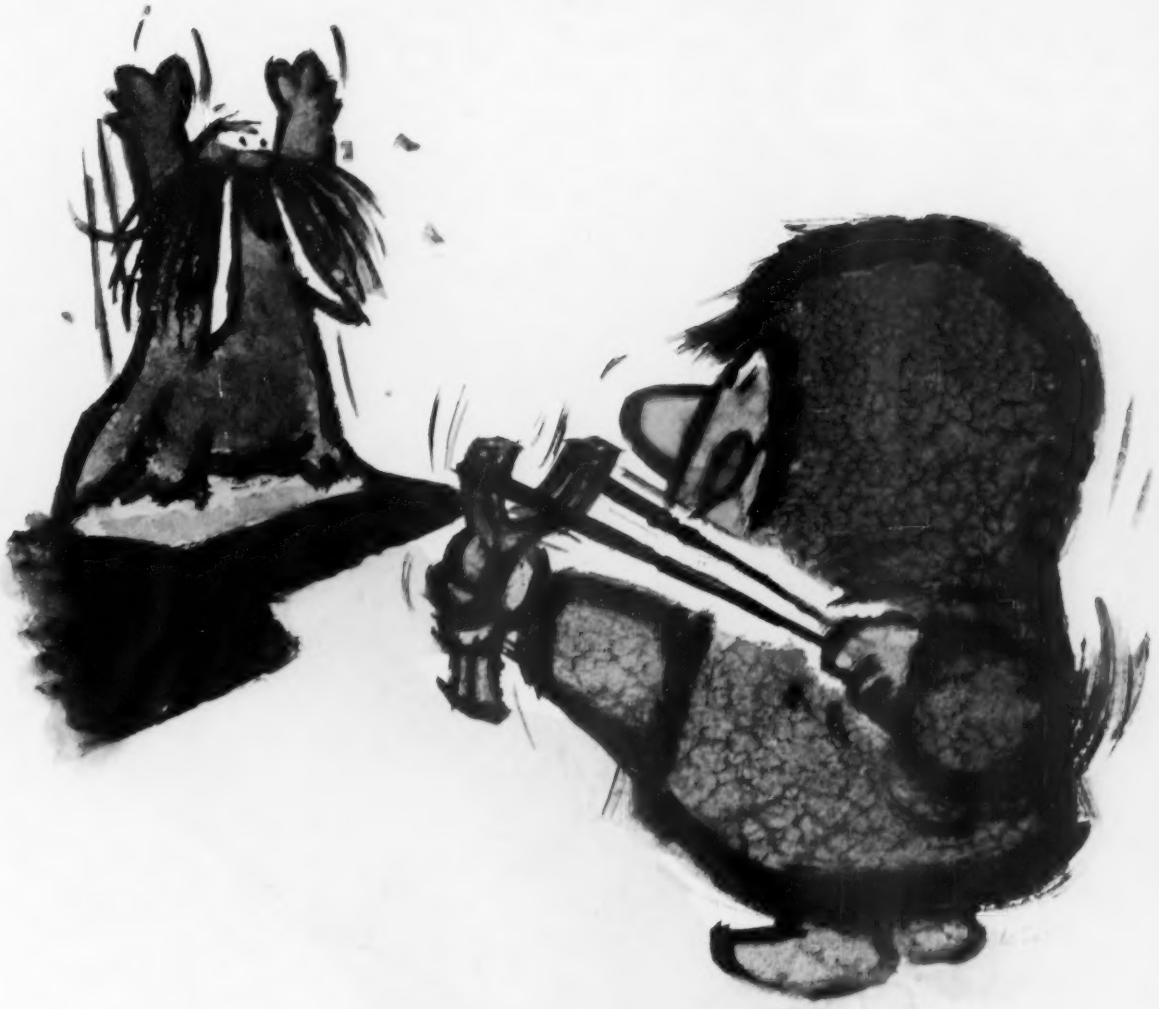
colored and holds a brilliant red basket in its arm. Dippy Duckling, an all-vinyl, five inch high, floating tub or pool toy, is colored yellow and red and quacks when squeezed. Donald Duck stands eight inches high, wears a new bright red jacket and quacks when squeezed. Another toy in Sun Rubber's 1957 line is a floating tub holding Huey, Dewey and Louie, Donald Duck's mischievous nephews.

Offers Translucent Hatch Tent

A new hatch tent which permits normal loading and discharging of cargo in inclement weather by keeping out rain and admitting light is now available from Herculite Protective Fabrics, Belleville, N. J. The tent is made of translucent vinyl reinforced with Fortisan F-36, a high strength yarn developed by the Celanese Corp. of America. According to Celanese, the amount of light transmitted to the normally darkened ship's hold is sufficient to permit normal loading under safe conditions. The new hatch tent weighs only half as much as tents manufactured from most conventional materials and may be erected and dismantled easily and quickly. Resistant to mildew or rotting even when wet, the tent can be stored compactly, without having been hung to dry, after use in rain or snow. The ridge type tent is 32 feet high and has a base measuring 29 by 45 feet.

Tri-Tex Vinyl Fabric

Middletown Rubber Corp., Middletown, Conn., has announced the development of "Tri-Tex" a triple-textured, three-dimension, valley printed vinyl fabric. The Tri-Tex method, used in the manufacture of the fabric, is utilized in deeply embossed valley prints on plastics whereby the "slopes" as well as the "valleys" are given a controlled ink deposit, resulting in an unusual 3-D decorative effect, the company says. The fabrics are offered in 54 inch width, various weights and in both vinyl coated fabrics and unsupported plastics.



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Most important, A-C Polyethylene Lubricants won't bloom in cured or uncured stocks; and they're non-staining, non-discoloring, non-migrating and non-toxic. Evaluate them in your own formulations. Ask your Barrett representative for technical data and samples.

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Pistol Grip Adapter

Pachmayr Gun Works, Inc., 1220 South Grand Ave., Los Angeles, Calif., has developed pistol grip adapters made of hard rubber and reinforced with Pliolite S-6B, to give "custom" fit to the grips of stock model pistols or revolvers. According to the company, the adapters

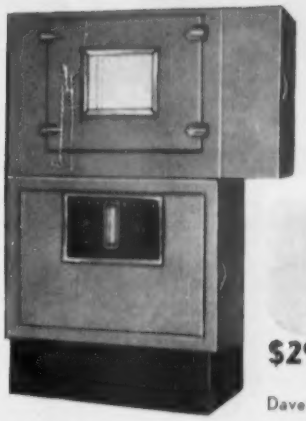
allow a firmer grip on the gun, reduce muzzle sway and improve accuracy. Produced in eight models in small, medium and large sizes, they are styled with a curved grip to fit such hand guns as the Smith and Wesson Chief, the Colt Cobra and various regulation police and military pistols. Adapters are made for Pachmayr by the Darnell Corp. of Downey, Calif.

Flexo Respiratory Masks

Flexo Products, Inc., Cleveland 13, Ohio, has introduced two new protective respiratory masks, the "Flex-A-Foam Dust Mask" and the "Flex-A-Prene Paint Mask." Said to be perfectly contoured for self-adjusting fit to every size and shape of face, the Flex-A-Foam mask consists of a pure latex filter, a two part interlocking polyethylene frame and a Defiance non-skid headband, with adjustable hook and eye fasteners. The frame is serrated to eliminate airleaks and the latex washable filter protects against non-toxic dust particles as small as 1 micron, the company says. The Flex-A-Prene mask has a special "Prenex" filter that will not soften, swell or jell when exposed to paint pigments or solvents, a two part interlocking polyethylene plastic frame and neoprene headband. All parts, designed to resist the attacks of solvents common to industrial type paints, are non-toxic and non-allergic, according to the company. The masks are easy to breathe through, weigh one ounce, and come apart for washing.

A new line of asbestos fiber gasketing materials in several types of rubber binders is now available from the Industrial Division of the Armstrong Cork Co. The new gasket compositions can be supplied as roll goods, sheets, or die-cut parts.

Model 700-1
OZONE
TEST CHAMBER



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Ozone Concentration Range: 15 to 1,000 pphm
Temperature Range: 5° below ambient to 200° F ±1° F.
Air velocity over sample: 2 feet/second
Chamber dimensions: 20" x 20" x 25" (5.7 cubic feet)
Floor space required: 54" x 28½"
Power requirements: 110-115 volts, 60 cycle, AC

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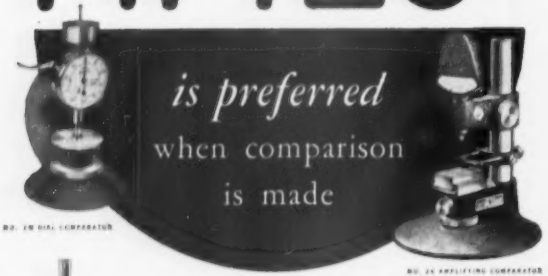

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New Equipment

Model LGH Scott Tester

A new tester for aging of elastomers at temperatures up to 1,000°F. has been announced by Scott Testers, Inc., 85 Blackstone St., Providence, R. I. The Model LGH Metal "Heatbath", has been developed in response to urgent demands for a means of evaluating value usefulness and endurance of rubber and plastic compounds at the elevated temperatures encountered in modern applications. A typical example is to evaluate the aging properties of flexible packings and seals in various installations where high temperatures will predominate, such as

jet propulsion, gas turbines and atomic energy plants. In the LGH, the specimens are tested in individual isolated compartments in an electrically heated stainless steel block. Metal bath construction is essential to prevent contamination due to "exchange" between the specimens. There is an inherent tendency of plasticizers and other volatile ingredients to migrate between samples unless exhausted or positively confined to each local test area. Such exchange migration, if permitted, could reverse the physical evaluation being made on a laboratory scale, and completely upset the performance when in actual use.

The LGH accomplishes positive isolation by providing 28 individual compartments holding "Vycor" test tubes in which contents are sealed. Temperature range of ambient—1000°F. is provided by 12,000 watt immersion heaters mounted around the block with ample area of insulation adjacent to the exterior shell, which is also of stainless steel. Suitable controls are integral, and tests show that desired temperatures are maintained within unbelievable tolerances. Model LGH, while new, is thoroughly grounded in experience with Model LG for temperatures up to 550°F. and also Model LGP, a similar heatbath for testing in pressured air or oxygen with each specimen completely isolated. Actual use of the LGH is not restricted to elastomers, but is useful in other fields such as various new textile products which show promise in high temperature application.

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TIRES POLYETHYLENE BUFFINGS

G-E X-Ray Microscope

A powerful new x-ray microscope which will aid in the study of contamination in chemicals, deterioration in fibers and distribution of particles in mixtures was recently introduced by the X-Ray Department, General Electric Co., Milwaukee 1, Wisconsin. The unit, magnifying objects up to 1500 times, may have some application in quality control of carbon black in the rubber field.

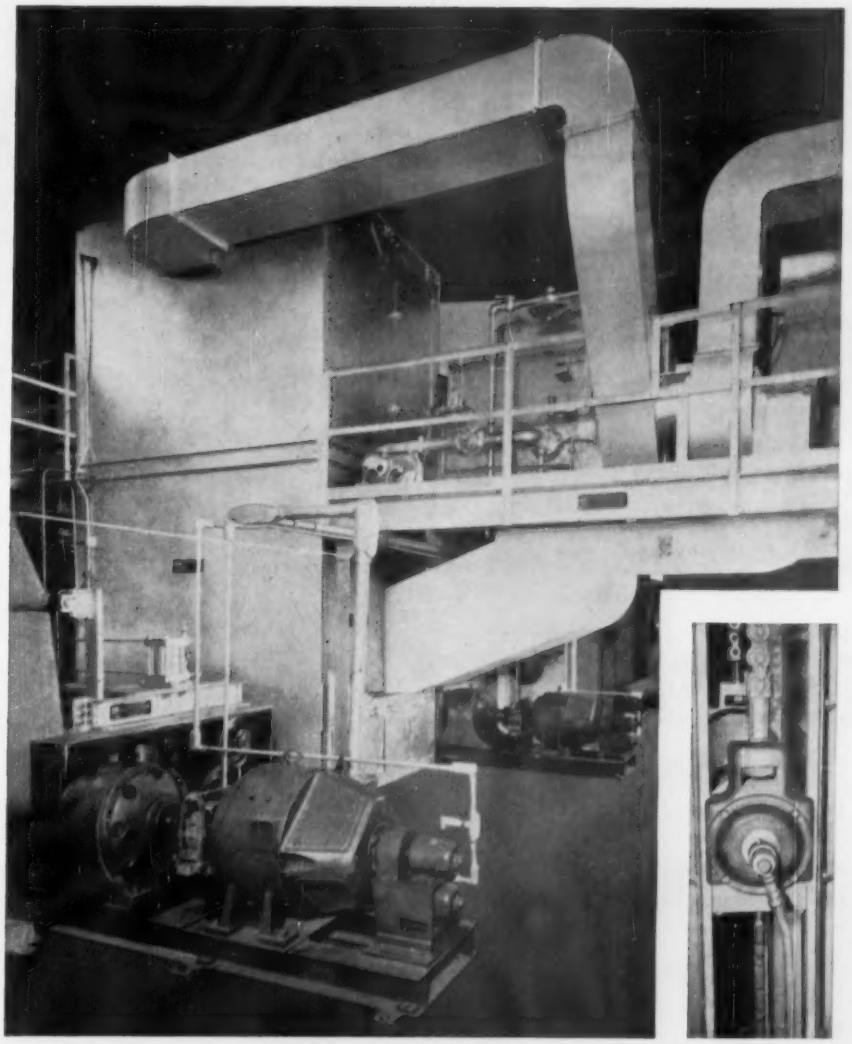
While not as powerful in its magnifying power as the electron microscope, the x-ray microscope is said to have an advantage in that it does not require mounting the specimen in a vacuum. It has an advantage over the optical microscope in depth of focus which permits three-dimensional examination of the specimen. Its claimed inherent advantage over both of these instruments is that it penetrates to the interior of the object and reveals structures otherwise not visible.

Basically, this is how the x-ray microscope works: A narrow beam of electrons emerges from an electron "gun." This beam is cut down to desired size by a condenser lens, and then passes through an objective lens. The tiny beam then bombards the target made of a sheet of tungsten which is thick enough to stop the electrons but thin enough to permit the generated x-rays to pass through. The remainder of the instrument is a simple shadow projection microscope. That is, a specimen placed near the x-ray source casts an enlarged image on a fluorescent screen, where it can be viewed by the eye, or on a photographic film where the image is recorded.

Portable High Frequency Heater

The new Seacastle Model R-4 heater made by Obel-P-Products is used in heating rubber blanks as well as for moisture measurements, dehydration and compression molding of plastics. The portable, lightweight unit has a maximum compound capacity of 2¼ pounds, operating frequency of 40.68 mc and a heating output of 1 kw or

about 75 BTU/minute. Convenient carrying handles enable it to be moved easily from place to place. An outstanding feature is the automatic opening of the oven door after the heat cycle, thus eliminating some of the operator's work and speeding up production. The unit has a time control adjustable from 0 to 5 minutes. The R-4 heater is available from Gary Wells Co., 149 Broadway, New York 6, N. Y.



Within the first day of startup, full width nylon tire cord processed in this 30-yard-per-minute, 14,000-pound-tension **IOI** Rollevator® Oven*, was made into aircraft tires meeting all qualification tests.

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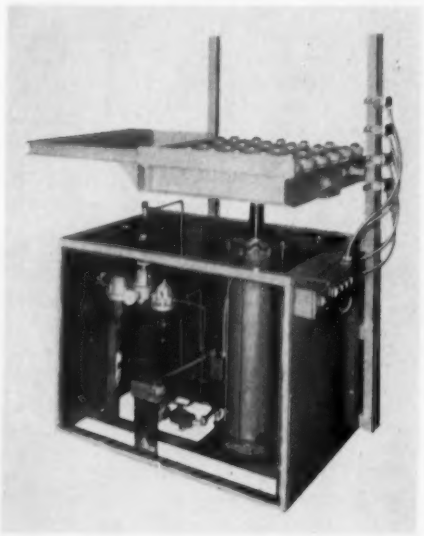
Loomis Elevating Loading Table

A new elevating loading table that is said to permit rapid and accurate loading and unloading of molds from a multiple opening press has been developed by the Loomis Engineering & Mfg. Co., 126 South 14th St., Newark 7, N. J. The unit, called the Loomis Model 130 Elevating Loading Table, is air-powered and is push-



button operated. The table accurately raises or lowers to any one of two or more pre-selected press opening levels by selecting the corresponding pushbutton, similar to an automatic office building elevator. Operating levels are easily adjusted. According to the manufacturer, size and load ratings can be provided to suit individual requirements. Either a plain or ball transfer table top can be provided.

Fischer & Porter Plastometer

An instrument for the continuous measurement of the consistency of fibrous or pulpy slurries has been developed by the Fischer & Porter Co., Hatboro, Penna. Designed primarily for use in the food industry, the F&P "Plastometer" is unique in that it permits automatic consistency control of products as heavy as ketchup or applesauce. The Plastometer consists of a simple hydraulic "flow-bridge", insensitive to flow rate fluctuations. Consistency is recorded in arbitrary units which bear excellent correlation with those of either Adams or Bostwick consistometers. The range of the F&P Plastometer is wider than those of consistometers currently available. Changes in range may be made without special tools or attachments. The Plastometer can be readily disassembled for cleaning.

Maneuvering of dies onto and from large or medium size inclined presses is facilitated with a new **die handling truck** developed by the Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio. The 5,000-lb capacity, electric-powered truck is equipped with a 44 x 50-inch rotating, tilting platform. Advantages are reduction of press down-time and elimination of damage to the dies or the press.

Valvair Directional Valve

A new directional valve, which affords instant switch-over from automatic to manual control of diaphragm-operated valves, cylinders and similar devices, has been announced by the Valvair Corp., Akron, Ohio. The new valve, installed as a tee in the inlet lines, permits manual take-over from automatic control, or control from two different sources, whenever desired. It also can be used to prevent inter-mixing of supply when two gases or liquids are being delivered alternately to a tank or container. Completely automatic in operation, the directional valve can be substituted for a dual top valve, the manufacturer says.

Simple in design, the new valve consists of a captive Hycar ball which shuttles between two seats in the Navy M bronze valve body. When pressure is applied to one port, the ball shifts to, and seals, the opposite port. Suitable for use with air, oil, water or media compatible with Hycar and bronze, the directional valve is available with ¼ and ⅜ N.P.T. ports. Net open area between seat and ball is equal to transverse area of ⅜ standard pipe.

Chemistry of Reinforcement

(Continued from page 1034)

ACKNOWLEDGMENT

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Reviews

BOOKS

Methoden der Organishen Chemie, "Houben-Weyl" (Methods of Organic Chemistry). (Fourth Edition). Edited by Eugen Müller in cooperation with O. Bayer, H. Meerwein and K. Ziegler. Published by George Thieme, Stuttgart, Germany. The complete series to consist of 20 volumes (16 nominal); average price $25.00 per volume; 7½ x 10½ inches (in German).

The old four volume "Houben-Weyl" has been out-of-print and out-of-date for more than twenty years, and many prewar organic chemists, who used to reach first for these four gospels of preparative organic chemistry, deplored this fact very much indeed. These old timers will be happy to have the trusted Houben-Weyl on hand again, and the newer generation can be considered lucky to be practicing organic chemistry at a time of its rebirth. The chemical industry should be grateful to Professor Müller, his co-workers and the publishers for their courage and devotion in making the Houben-Weyl available again. The editors and contributors are recruited from both industry and the academic profession. From the quality of the volumes published to date, it can already be stated that the new Houben-Weyl promises to be not only a monumental undertaking, but also a monument to modern cooperation of men from industry and higher learning.

To give a comprehensive, critical review of the Houben-Weyl which is being compiled by about 180 experts in various fields would neither be possible nor appropriate for any single reviewer. The comments to be presented in the course of this review will aim primarily at telling the impressions this reviewer gained in browsing through the volumes and at indicating the content and the usefulness of the volumes for organic chemists in general, and those in the rubber industry in particular.

Rubber chemistry, in the past often labelled an art more than a science, is no longer in this category. To make intelligent use of modern polymers and compounding ingredients, familiarity with organic chemical reactions is an absolute necessity for compounders. It is self-evident that, if this is the case with chemists working as compounders, rubber chemists working on the development of new polymers and compounding ingredients must certainly be thoroughly familiar with the techniques of preparative organic chemistry. The Houben-Weyl provides the opportunity to acquire this familiarity. Basic knowledge of organic chemistry is, of course, a main requirement to be able to use the Houben-Weyl, as is a good reading knowledge of German, but chemists equipped with these prerequisites will find the Houben-Weyl the most helpful reference work and manual for practicing organic chemistry.

"Methoden der Organischen Chemie" is not just another collection of methods to be tried, but consists of critically selected material. Theoretical subjects are presented in a candid manner; analytical procedures and preparative methods can be followed in most cases without the need of referring to the original literature which, however, is exhaustively quoted. The volumes published to date reveal that great care is being taken to present methods which are operative and/or characteristic for the reactions under discussion.

The editors have planned to present in the first four volumes general methods, and in Volume V to XV specialized and specific analytical and preparative procedures. Volume XVI is planned to be basically a general index of the whole set of volumes. The following outline for the work was given by the publisher:

Volume I: Vorbereitende und Hilfsmethoden im Laboratorium (Preparatory and Auxiliary Laboratory Methods)

Volume II: Analytische Methoden (Analytical Methods)

Volume III: Physikalische Forschungsmethoden in der Organischen Chemie (Physical Methods of Investigation in Organic Chemistry)

Volume IV: Allgemeine Chemische Methoden (General Chemical Methods)

Volume V through Volume XV: Spezielle Chemische Methoden (Special Chemical Methods).

Volume XVI: Symbolik, Benennung, Literature Gesamtregister (Symbology, Name Designations, Literature, General Index).

After completion of the scheduled volumes, supplements are contemplated to keep the work up to date. When first announced in 1952, the publishers promised to have the complete series published in a few years. The editors are keeping their promise well, as seven volumes had been published by December, 1955. The first volume to appear was Volume VIII. The other volumes published so far are II, III/1, III/2, IV/2, VII/1 and IX.

Timing, in publishing a comprehensive work, is a very difficult matter, especially when dealing with a great number off authors. The volumes are therefore scheduled to appear in irregular sequence. 'Zwanglos' is the German word for it, which also means 'without constraint or compulsion'. Anyhow, Volume I is still to be published. It is hoped that it will be available soon, since a comprehensive treatise of general laboratory techniques, such as the proposed contents indicate the volume will be, is always highly welcome reading matter for a laboratory chemist, and because it can be expected that ready availability of good laboratory procedures and manipulations will contribute to better utilization of the methods discussed in the other volumes. Judging from the prepublished index, which lists all important manipulations carried out in an organic chemistry laboratory, and trusting that this volume will be of the caliber to be expected from a Houben-Weyl volume, this reviewer is anxiously awaiting the appearance of Volume I.

EDITOR'S NOTE: Reviews of the individual volumes will appear in future issues of RUBBER AGE.

F. R.

•

Symposium on Speed of Testing of Non-Metallic Materials. (Special Technical Publication 185). American Society for Testing Materials, 1916 Race St., Philadelphia 3, Penna. 6 x 9 in. 86 pp. $2.50.

Eight papers included in the A.S.T.M. symposium given in 1955 are published in this new volume, bringing together various data on the effect of testing speed on most nonmetallic materials. Covered specifically are the effects on the tension test of elastomers and hard rubber, in the mechanical testing of plastics, and on other materials such as paper, concrete, wood, glass and yarn. The symposium covers testing from very slow to very rapid rates. Graphs, charts and photographs are used extensively. An earlier publication on a "Symposium on Speed of Testing" is also available from the ASTM for $1.25 per copy, or $3.50 when included with Publication 185 as a combination.

•

Rubber Workers' History (1935-1955). By Dr. John N. Thurber. Published by United Rubber, Cork, Linoleum and Plastic Workers of America, 87 South High St., Akron 8, Ohio. 7½ x 10¼ in. 48 pp.

The development of the rubber workers' union from the early thirties to the present day is traced in this book, originally printed in the *United Rubber Worker* and published in booklet form due to popular demand. The trials and tribulations of union growth, including strikes, negotiations, changes brought about by world wars, effects of government legislation, and internal politics are described. The part played by the URW in international trade unionism is also dealt with. Photos of leading figures in both union ranks and industry, and statistics on wages, sales, etc., complete the comprehensive treatment.

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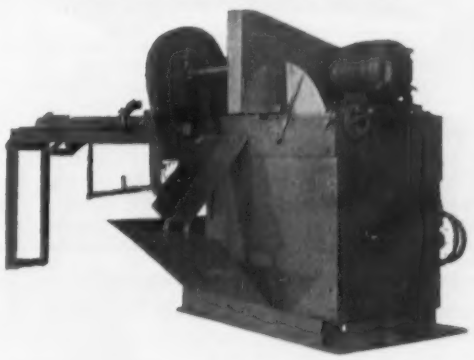

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BOOKLETS, CATALOGS, etc.

Dielectric Ovens. (Bulletin No. 56-E). Young Brothers Co., 1831 Columbus, Cleveland 13, Ohio. 8½ x 11 in. 4 pp.

The newest method of heating, baking, drying or curing non-metallic, non-conductive material, dielectric, or electronic heating, is described in this bulletin. In this new method, heat is developed uniformly throughout a homogeneous material as its molecules react violently to high frequency radio energy generated by an electronic tube. This energy is directed into the material by a pair of electrodes between which the material passes on a continuously moving conveyor. Since the heat is developed uniformly within the material, the rate of heating is greatly accelerated over rates obtained by radiant or convection heating methods. Where these methods often require hours, dielectric heating can frequently reduce heating or baking time to minutes—or even seconds. The publication also describes and pictures standard models of the company's dielectric ovens and heaters and gives their dimensions and power output ratings.

•

Fawick Standardized Press Application. (Bulletin ML-172). Fawick Airflex Division, Fawick Corp., 9919 Clinton Road, Cleveland 11, Ohio. 8½ x 11 in. 16 pp.

The complete Fawick line of package applications for modernization of presses and similar machinery with pneumatic clutch and brake is discussed in this bulletin. These packages, called Fawick Standardized Press Applications, consist of: Fawick CB Airflex Clutches, CS Brakes, Timing Rotorseals, High-Speed Clutch Controls and new flywheels mounted on anti-friction bearings. They are complete and ready to install with a simple machining of the crankshaft end. The bulletin contains data on how to select the proper application for a press, complete dimension and flywheel inertia information in table form, photographs of a typical press equipped with FSPA, descriptive material on the Timing Rotorseal and High-Speed Clutch Controls, and detailed price tables.

•

Grinding And Mixing Equipment. (Bulletin No. 280). U. S. Stoneware Co., Akron 9, Ohio. 8½ x 11 in. 24 pp.

In addition to detailed information on the complete line of grinding and mixing equipment offered by the company, this bulletin incorporates a special chapter dealing with Principles of Jar, Ball and Pebble Milling. This helpful and informative section describes the various types of mills, linings and grinding media available, and discusses applications for each type. A chapter on Milling Procedures covers all phases of mill operation. Together with comprehensive technical data, this publication offers many practical suggestions and recommendations for all users of mixing and grinding equipment. Illustrations, data and specifications are furnished on the firm's expanded line of grinding and mixing equipment including complete information on jar mills, ball and pebble mills, mill jars, grinding media, drum rollers and tumblers, and special mixing equipment.

•

Unitex Centrifuged Natural Hevea Latex. Stein, Hall & Co., Inc., 285 Madison Ave., New York 17, N. Y. 8½ x 11 in. 20 pp.

A complete description of Unitex centrifuged hevea latex which is sold exclusively in the United States by Stein Hall is offered in this booklet. The booklet follows the production of the latex from the planting of the rubber trees to its ultimate delivery to consumers. It also gives detailed information on the services offered by the company and lists the rigid specifications which have been set up for Unitex. Illustrated throughout, the booklet depicts the many steps taken to insure a high quality latex.

Industrial Ovens And Dryers: Safe Installation And Operation. (Loss Prevention Bulletin No. 14.15). Factory Mutual Engineering Division, Associated Factory Mutual Fire Insurance Companies. 1151 Boston-Providence Turnpike, Norwood, Mass. 8½ x 11 in. 40 pp. $1.00.

This booklet gives basic information on means of preventing explosions and fires caused by industrial ovens and dryers. A comprehensive study, the material is dealt with in seven chapters which include instructions on the location and construction of ovens and dryers, prevention of fires, fuel explosions and vapor explosions, and testing procedures. Each chapter is broken down into categories dealing with every aspect of the topic in lucid detail. A complete series of charts and illustrations as well as a glossary supplement the guide book.

•

Stokers. (Bulletin No. 562). The Johnston & Jennings Co., Division of Pettibone Mulliken Corp., 6917 Bessemer Ave., Cleveland 27, Ohio. 8½ x 11 in. 20 pp.

This new catalog describes the operation and advantages of the J & J modified travelling grate type stoker that compensates for loss of volume in the fuel bed as the combustibles are burned out, maintaining even depth of the fuel bed from front to rear and side to side. It describes a variety of installations, and lists a typical heat balance table and also a useful tabulation showing the dimensions of standard stokers that will meet a wide variety of effective grate area requirements.

•

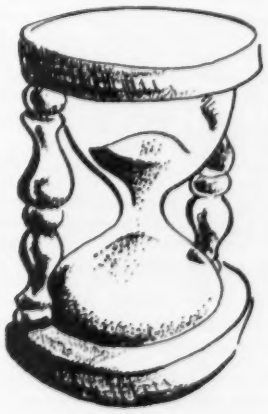
Union Carbide W-96—Silicone Rubber Gum Stock. Silicones Division, Union Carbide and Carbon Corp., 30 East 42nd St., New York 17, N. Y. 8½ x 11 in. 28 pp.

This new data sheet and compounding study on Union Carbide "W-96 Silicone Rubber Gum Stock" provides detailed information and instructions for manufacturers, fabricators and product designers. It includes numerous tables and charts not previously available. The publication details the manner in which W-96 a vinyl-containing methyl silicone gum, has proven to have a much wider range of usefulness than the original dimethyl silicone gums.

•

Fundamental Mechanisms in Polyethylene Extrusion. Bakelite Company, 30 East 42nd St., New York 17, N. Y. 8½ x 11 in. 20 pp.

Results of an investigation of theories leading to production of high quality resins for contour extrusion products are presented in this booklet. The data provide a comprehensive resume of fundamental variable in polyethylene extrusion. Use of 18 graphs, involving pressure, flow rate, channel depth, die resistance, resin temperature and viscosity, cylinder temperature and mechanical work, supplements the presentation.



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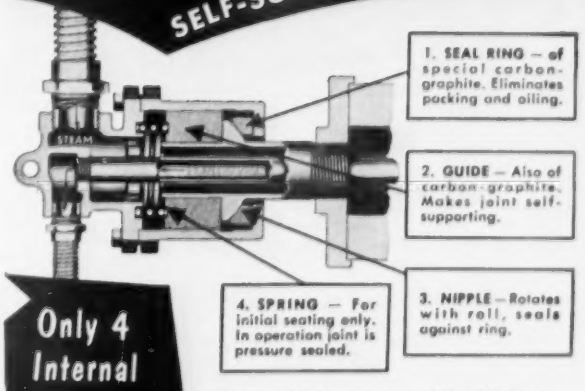
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MARKET REPORTS

TRENDS
NEWS
PRICES

Natural Rubber

Since our last report (January 31), the price of spot rubber on the New York Commodity Exchange has moved in a range of 200 points, high for the period being 31.63c reached on February 1, and low being 29.63c reached on February 18 and again on February 25. The average price of spot rubber for the month of February was 30.43c based on 18 trading days. This compares with an average of 33.32c in the previous month.

Few in the trade are inclined to look for any pronounced price swings in natural rubber in the immediate future. Technical rallies are expected to be witnessed from time-to-time, but for the most part the inclination is to look for a slow sagging trend.

This feeling has been created by the clear indication of a falling off in natural consumption abroad, with the exception of Russia and China. Increased takings by Iron Curtain countries has done much to counterbalance the decline in absorption in other areas.

There seems to be a great deal of uneasiness over the world economic situation, and because of this, buyers' confidence is lacking. At the same time, there does not appear to be any major trend in the making which would attract the speculative element.

Natural Picture Shifts

In contrast to expectations of just a few months ago, there should be an extra monthly availability of some 12,000 tons of natural in 1957 for the world market. The sooner that the gas and oil rationing program ends in Europe, the sooner European consumption will increase. In fact, it is possible that should such rationing terminate before mid-year, there could be an almost exact balance between world production and world consumption in the calendar year.

If rationing should continue for the full year, however, a 1957 world surplus of about 50,000 tons of natural would occur. Such a surplus would still be very small. In the poorest of the past three years (1954), the average New York spot price for No. 1 R.S.S. was nearly 24c. Costs, however, have risen and now 30c is considered a justifiable price to attract supplies and to meet demand.

In view of the resemblance of the present price pattern and surrounding economic conditions a year ago, it is likely that the 1956 lows for natural could well be tested (around 26c basis nearby futures) and that future business sentiment may determine whether prices will hold and reverse at that point.

Price Stability Promising

Some measure of price stability looks promising near present levels because of the factors of world consumer inventory depletion, more normal primary area stocks, and "wintering". A very favorable impact could be caused by the end of rationing abroad which might be contagious and affect business conditions everywhere. Another telling influence will be Spring automobile sales.

NEW YORK, FEBRUARY 28, 1957

Price Data

Closing Rubber Prices on New York Commodity Exchange

FROM FEBRUARY 1 TO FEBRUARY 28

Feb.	Spot	Mar.	May	July	Sept.	Sales
1	31.63	31.35	30.87	30.57	30.25	117
2	....	....	....	....	....	...
3	....	....	....	....	....	...
4	30.13	30.15	29.88	29.40	29.10	263
5	29.88	29.75	29.50	29.10	28.80	338
6	30.50	30.30	30.00	29.60	29.30	228
7	30.38	30.10	29.95	29.60	29.25	198
8	30.63	30.60	30.35	29.85	29.60	87
9	....	....	....	....	....	...
10	....	....	....	....	....	...
11	30.63	30.65	30.25	29.85	29.60	46
12	....	....	....	....	....	...
13	31.13	31.03	30.77	30.45	30.00	113
14	30.63	30.45	30.35	30.00	29.75	40
15	30.75	30.50	30.45	30.05	29.80	136
16	....	....	....	....	....	...
17	....	....	....	....	....	...
18	29.63	29.50	29.65	29.25	28.95	125
19	30.00	29.80	29.85	29.55	29.25	77
20	30.13	29.90	30.00	29.70	29.50	121
21	30.13	30.10	30.14	29.85	29.60	25
22	....	....	....	....	....	...
23	....	....	....	....	....	...
24	....	....	....	....	....	...
25	29.63	29.50	29.60	29.40	29.20	86
26	30.50	30.20	30.40	30.20	30.05	112
27	30.50	30.20	30.40	30.30	30.15	93
28	31.00	31.00	31.00	30.80	30.62	150

Outside Market

No. 1 Ribbed Smoked Sheets:	
Spot	.31
March	.31
April	.31
Thin Latex Crepe:	
Spot	.35¼
Thin Brown Crepe, No. 2	.27½
Flat Bark Crepe	.20⅞

London Market
(Standard Smoked Sheets)

May	30.60 - 30.75
July-Sept.	30.46 - 30.60

Singapore Market
(Standard Smoked Sheets)

Apr.	28.90 - 29.01

Middling Upland Quotations

	Jan. 31	February 28		
	Close	High	Low	Close
Mar.	34.87	35.27	35.17	35.19
May	34.82	35.25	35.19	35.25
July	34.29	34.68	34.61	34.68

Notes & Quotes

Upon announcing distribution of a new set of natural rubber standards aimed at improving quality, W. J. Sears, chairman of the Crude Rubber Committee, Rubber Manufacturers Association, noted that in 1955 only 62.6 per cent of all the natural rubber reaching the U. S. conformed to RMA grades. The new standards, said Mr. Sears, provide the tools to bring about greater improvement in the marketing of rubber. Mr. Sears expressed his belief that this agreement by all organizations for the first time to produce, grade, pack and ship rubber against a single set of uniform standards will do much to improve the quality of natural rubber imports into this and other consuming countries of the world.

Synthetic Rubber

It has been a great many months since the synthetic rubber outlook has exerted influence on natural rubber prices to any degree. At the present time, the rubber trade both here and abroad seems to be more apprehensive over possible synthetic rubber developments than any other single factor.

It is clearly established that the productive capacity of the synthetic rubber industry in the United States will continue to rise. The question arises as to whether the rate of consumption in the United States will be sufficiently great and the rate of exports sufficiently large to warrant an increased rate of production.

As a matter of fact, the trend of increased stocks of synthetic rubber in the United States is having much to do with shaping sentiment in natural rubber. The feeling is gaining ground that curtailed exports of synthetic rubber from the United States will be reflected in a slowing down of synthetic rubber production, at least for a time.

Synthetic Price Picture

The trade reports that a none too comfortable position may be developing in the synthetic rubber position in the United States. With the price of natural rubber progressively declining and with the lower grades relatively cheaper than synthetic abroad, there is a feeling that price concessions on synthetic rubber may be needed to stimulate exports. The alternative may be curtailed production in the United States.

It seems to be the consensus that a test in the open market both here and abroad is in the making. The answer will certainly develop in the coming months. This is the first time since private industry took over the synthetic rubber plants that such a situation has developed.

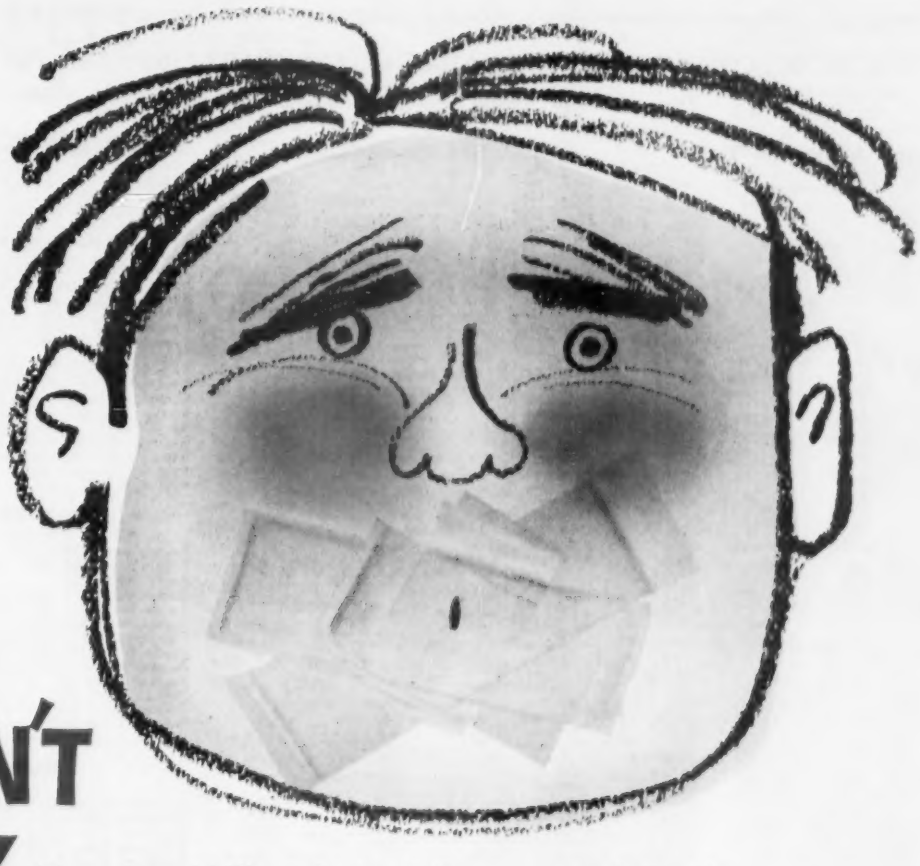
The trade feels that there is no question of the need for substantial export business to encourage a high rate of output. At the same time, price is an all-important influence, especially as dollars are not too readily available abroad.

At the end of 1956, domestic synthetic rubber stocks totaled 200,000 long tons. This is about a two months' supply in terms of consumption and record export demand. Even if exports hold up, the stock level would still be about a two month supply based on estimated 1957 domestic use.

Synthetic Capacity Rising

It is expected that in the United States alone, productive capacity for synthetic rubber will rise to nearly 1,700,000 long tons in 1957. It is also known that lower styrene prices will take effect about mid-year. These factors may put pressure on synthetic prices and, in turn, on natural prices.

In consideration of the fact that the output of synthetic rubber can be controlled, however, many in the trade believe that most of these "pressures" on the synthetic price structure will not develop.



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at Cyanamid's MBTS plant—for the unique processing methods

explain why the product is exceptional by previous MBTS standards.

But "Production" tells us it's still "trade secret," and we're limited

to telling you about the results...

"Safe" "Non-Scorchy" "Long-Curing Plateau" ... these well-known characteristics of Benzothiazyldisulfide make it ideal for most curing uses and there's no premium for the extras of Cyanamid MBTS. Why not send for a technical bulletin—or contact your local Cyanamid Rubber Chemicals distributor.

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AMERICAN CYANAMID COMPANY

RUBBER CHEMICALS DEPARTMENT

BOUND BROOK, NEW JERSEY

THE BEST MBTS EVER SEEN!

- **Dust-free, excellent dispersion... for Cyanamid MBTS has the most uniform particle size ever offered.**
- **Economical use... due to unsurpassed high MBTS content and purity. Every ounce works.**
- **Easier, neater handling and more compact storage... thanks to a vacuum-packed bag with no "slack."**
- **Assured quality all the way... for Cyanamid makes MBTS step by step from its own aniline.**

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PRICES OF COMMERCIALLY AVAILABLE SYNTHETIC RUBBER POLYMERS

(dry types—per pound carload unless otherwise specified)

Butadiene-Acrylonitrile Types

Butaprene NAA	.5400 [1]
Butaprene NF	.4900 [1]
Butaprene NL	.5000 [1]
Butaprene NXM	.5800 [1]
Chemigum N1	.6400 [2]
Chemigum N3	.5800 [2]
Chemigum N5	.5800 [2]
Chemigum N6	.5000 [2]
Chemigum N7	.5000 [2]
Hycar 1001	.5800 [2]
Hycar 1002	.5000 [2]
Hycar 1014	.6000 [2]
Hycar 1041	.5800 [2]
Hycar 1042	.5000 [2]
Hycar 1043	.5000 [2]
Hycar 1312	.5000 [2]
Hycar 1411	.6200 [2]
Hycar 1432	.5900 [2]
Hycar 1441	.6200 [2]
Paracril AJ	.4850 [2]
Paracril B	.5000 [2]
Paracril BJ	.5000 [2]
Paracril BLT	.5000 [2]
Paracril C	.5800 [2]
Paracril CV	.5900 [2]
Paracril D	.6500 [2]
Paracril 18-80	.6000 [2]
Polysar Krynac 800	.5000 [3]
Polysar Krynac 801	.5800 [3]
Polysar Krynac 802	.5000 [3]
Polysar Krynac 803	.5000 [3]

Butadiene-Styrene Types

Ameripol 1000	.2410 [3]
Ameripol 1001	.2410 [3]
Ameripol 1002	.2435 [3]
Ameripol 1006	.2410 [3]
Ameripol 1007	.2425 [3]
Ameripol 1009	.2475 [3]
Ameripol 1500	.2410 [3]
Ameripol 1501	.2410 [3]
Ameripol 1502	.2410 [3]
Ameripol 1703	.2060 [3]
Ameripol 1705	.2035 [3]
Ameripol 1707	.1910 [3]
Ameripol 1708	.1910 [3]
Ameripol 1710	.1885 [3]
Ameripol 1712	.1885 [3]
ASRC 1000	.2410 [3]
ASRC 1001	.2410 [3]
ASRC 1004	.2410 [3]
ASRC 1006	.2410 [3]
ASRC 1018	.2700 [3]
ASRC 1019	.2650 [3]
ASRC 1500	.2410 [3]
ASRC 1502	.2410 [3]
ASRC 1503	.2625 [3]
ASRC 1703	.2060 [3]
ASRC 1708	.1910 [3]
Baytown 1600	.1760 [3]
Baytown 1601	.1760 [3]
Baytown 1602	.1760 [3]
Baytown 1801	.1600 [3]
Copo 1500	.2410 [3]
Copo 1502	.2410 [3]
Copo 1505	.2610 [3]
Copo 1712	.1885 [3]
FR-S 1000	.2410 [3]
FR-S 1001	.2410 [3]

Butadiene-Styrene (Cont'd)

FR-S 1004	.2410 [3]
FR-S 1006	.2410 [3]
FR-S 1009	.2475 [3]
FR-S 1010	.2600 [3]
FR-S 1012	.2425 [3]
FR-S 1013	.2500 [3]
FR-S 1014	.2810 [3]
FR-S 1015	.2910 [3]
FR-S 1500	.2410 [3]
FR-S 1502	.2410 [3]
FR-S 1703	.2060 [3]
FR-S 1705	.2035 [3]
FR-S 1712	.1885 [3]
Naugapol 1016	.2650 [3]
Naugapol 1018	.2700 [3]
Naugapol 1019	.2650 [3]
Naugapol 1021	.3000 [3]
Naugapol 1022	.2800 [3]
Naugapol 1023	.2850 [3]
Naugapol 1503	.2625 [3]
Naugapol 1504	.2950 [3]
Philprene 1000	.2410 [1]
Philprene 1001	.2410 [1]
Philprene 1006	.2410 [1]
Philprene 1009	.2475 [1]
Philprene 1010	.2600 [1]
Philprene 1018	.2700 [1]
Philprene 1019	.2650 [1]
Philprene 1100	.1920 [1]
Philprene 1104	.1880 [1]
Philprene 1500	.2410 [1]
Philprene 1502	.2410 [1]
Philprene 1503	.2625 [1]
Philprene 1600	.1910 [1]
Philprene 1601	.1910 [1]
Philprene 1605	.1880 [1]
Philprene 1703	.2060 [1]
Philprene 1706	.2030 [1]
Philprene 1708	.1910 [1]
Philprene 1712	.1880 [1]
Philprene 1803	.1730 [1]
Plioflex 1006	.2410 [3]
Plioflex 1500	.2410 [3]
Plioflex 1502	.2410 [3]
Plioflex 1703	.2060 [3]
Plioflex 1710	.1885 [3]
Plioflex 1712	.1885 [3]
Plioflex 1773	.2060 [3]
Plioflex 1778	.1910 [3]
Polysar Kryflex 200	.2410 [3]
Polysar Krylene	.2410 [3]
Polysar Krylene NS	.2410 [3]
Polysar Krynol 651	.1885 [3]
Polysar Krynol 652	.1910 [3]
Polysar S	.2410 [3]
Polysar S-50	.2410 [3]
Polysar S-X 371	.2550 [3]
Polysar SS-250	.3000 [3]
S-1000	.2300 [3]
S-1001	.2300 [3]
S-1002	.2325 [3]
S-1006	.2300 [3]
S-1011	.2325 [3]
S-1013	.2300 [3]
S-1100	.1850 [3]
S-1500	.2300 [3]
S-1502	.2300 [3]
S-1600	.1800 [3]
S-1601	.1800 [3]
S-1602	.1800 [3]

Butadiene-Styrene (Cont'd)

S-1703	.1950 [3]
S-1706	.1925 [3]
S-1707	.1800 [3]
S-1709	.1775 [3]
S-1712	.1775 [3]
S-1801	.1650 [3]
Synpol 1000	.2410 [1]
Synpol 1001	.2410 [1]
Synpol 1002	.2435 [1]
Synpol 1006	.2410 [1]
Synpol 1007	.2410 [1]
Synpol 1009	.2475 [1]
Synpol 1012	.2425 [1]
Synpol 1013	.2500 [1]
Synpol 1061	.2410 [1]
Synpol 1500	.2410 [1]
Synpol 1502	.2410 [1]
Synpol 1551	.2410 [1]
Synpol 1703	.2060 [1]
Synpol 1707	.1910 [1]
Synpol 1708	.1910 [1]
Synpol 1711	.1900 [1]

Butyl Rubbers

Enjay Butyl 035	.2300 [3]
Enjay Butyl 150	.2300 [3]
Enjay Butyl 165 NS	.2400 [3]
Enjay Butyl 215	.2300 [3]
Enjay Butyl 217	.2300 [3]
Enjay Butyl 218	.2300 [3]
Enjay Butyl 268 NS	.2400 [3]
Enjay Butyl 325	.2300 [3]
Enjay Butyl 365 NS	.2400 [3]
Polysar Butyl 100	.2450 [3]
Polysar Butyl 101	.2775 [3]
Polysar Butyl 200	.2450 [3]
Polysar Butyl 300	.2450 [3]
Polysar Butyl 301	.2550 [3]
Polysar Butyl 400	.2450 [3]

Neoprene

	(prices l.c.l.)
Neoprene Types AC and CG	.5500 [3]
Neoprene Type GN	.4100 [3]
Neoprene Type GN-A	.4100 [3]
Neoprene Type GRT	.4200 [3]
Neoprene Type KNR	.7500 [3]
Neoprene Type S	.4200 [3]
Neoprene Type W	.3900 [3]
Neoprene Type WHV	.3900 [3]
Neoprene Type WRT	.4500 [3]
Neoprene Type WX	.4100 [3]

Silicone Rubbers*

	(prices l.c.l.)
GE (compounded)	2.50 [3]
GE Silicone Gum (not compounded)	4.00 [3]
Silastic (compounded)	1.90 [3]
Union Carbide (gums)	4.00 [3]
Union Carbide (compounds)	2.50 [3]

Polysulfide Rubbers

	(prices l.c.l.)
Thiokol Type A	.4700 [3]
Thiokol Type FA	.6400 [3]
Thiokol PR-1	.9500 [3]
Thiokol Type ST	1.00 [3]

(latices—all prices per pound dry weight)

Butadiene-Acrylonitrile Types

Butaprene N-300	.4600 [1]
Butaprene N-400	.5400 [1]
Butaprene N-401	.5400 [1]
Chemigum 200	.4900 [2]
Chemigum 235	.5400 [2]
Chemigum 236	.5400 [2]
Chemigum 245	.4600 [2]
Chemigum 246	.4600 [2]
Hycar 1512	.4600 [2]
Hycar 1551	.5400 [2]
Hycar 1552	.4600 [2]
Hycar 1561	.5400 [2]
Hycar 1562	.4600 [2]
Hycar 1571	.5400 [2]
Hycar 1572	.5100 [2]
Hycar 1577	.4600 [2]
Hycar 1852	.4400 [2]

Butadiene-Styrene Types

Copo 2101	.3000 [3]
Copo 2102	.3200 [3]

Butadiene-Styrene (Cont'd)

Copo 2105	.3200 [3]
Copo X-765	.3000 [3]
FR-S 2000	.2600 [3]
FR-S 2001	.2600 [3]
FR-S 2002	.2850 [3]
FR-S 2003	.2950 [3]
FR-S 2004	.2950 [3]
FR-S 2006	.2600 [3]
FR-S 2105	.3100 [3]
Pliolite 2101	.3000 [3]
Pliolite 2104	.3200 [3]
Pliolite 2105	.3200 [3]
Pliolite X-765	.3000 [3]
Naugatex 2000	.2630 [3]
Naugatex 2001	.2630 [3]
Naugatex 2002	.2880 [3]
Naugatex 2006	.2630 [3]
Naugatex 2105	.3120 [3]
Naugatex X-765	.2900 [3]
Naugatex X-767	.3120 [3]

Butadiene-Styrene (Cont'd)

S-2000	.2275 [3]
S-2004	.2600 [3]
S-2105	.3100 [3]
S-2006	.2150 [3]
S-2102	.2250 [3]

Neoprene

Neoprene Latex 60	.4000 [3]
Neoprene Latex 571	.3700 [3]
Neoprene Latex 572	.3900 [3]
Neoprene Latex 601-A	.4000 [3]
Neoprene Latex 735	.3800 [3]
Neoprene Latex 736	.3800 [3]
Neoprene Latex 842-A	.3700 [3]
Neoprene Latex 950	.4700 [3]

Polysulfide Rubbers

Thiokol Type MX	.7000 [3]
Thiokol Type WD-2	.9200 [3]
Thiokol Type WD-6	.7000 [3]

Notes: (1) Freight allowed. (2) Freight extra. (3) Freight prepaid. * Covers a wide range of compounds. Readers are urged to check specific prices with producers.

MARKETS

(continued)

Reclaimed Rubber

Official U. S. Department of Commerce figures show that 286,822 long tons of reclaimed rubber were produced in the United States in 1956 and 291 long tons imported, making a total net new supply of 287,113 long tons. Of the 326,646 long tons in new supply in 1955, 325,914 were produced and 732 were imported.

The Commerce Department figures show that 271,038 long tons of reclaim were consumed in 1956, against the 312,781 long tons consumed in the previous year. Exports during 1956 totaled 12,930 long tons, about 400 long tons more than in the previous year. As of December 31, 1956, there were 34,878 long tons in stocks on hand, approximately 3,400 long tons more than at the end of 1955.

The recent fire at the Butler, N. J., plant of the Pequanoc Rubber Co., reported on elsewhere in this issue, may cause some market readjustments. At this writing, however, it is still too early to determine what effects, if any, the fire will have.

(Prices for All Areas Except Calif.)

	per lb.
Premium Grade Whole Tire	.11½
First Line Whole Tire	.11
Second Line Whole Tire	.10½
Third Line Whole Tire	.10¼
Fourth Line Whole Tire	.09¾
Black Carcass	.15¼
No. 1 Light Colored Carcass	.22
No. 1 Peel	.11
Butyl Tube Reclaim	.14
Natural Rubber Black Tube	.16
Natural Rubber Red Tube	.21
Natural Rubber Gray Tube	.21

Scrap Rubber

There have been few new developments in the scrap rubber market during the past period. Suppliers have been awaiting the placement of the monthly order for mixed automobile tires for March shipment. Prices, despite the lack of volume business, remain stable.

Perhaps the only bright spot in the scrap rubber picture is the export market. Scrap rubber exports for the first ten months of 1956 are estimated at 38,300,365 pounds. This figure exceeded exports in the first ten months of 1955 by about 8,000,000 pounds.

The outlook for 1957 is not too promising in the view of many in the trade. If prices are such as to continue to make the handling of scrap rubber unprofitable, many collectors and dealers may stop trading.

(Prices Delivered Akron)

Mixed tires	ton	16.00
Light colored carcass	lb.	.05½
No. 1 peelings	ton	45.00
No. 2 peelings	ton	30.00
No. 3 peelings	ton	20.00
Buffings	ton	16.00
Truck and Bus S.A.G.	ton	19.00
Passenger S.A.G.	ton	17.50
Natural Rubber Red Tubes	lb.	.07¾
Natural Rubber Black Tubes	lb.	.07
Butyl Rubber Tubes	lb.	.04½

Tire Fabrics

According to current reports, trading in wide industrial fabrics remains extremely slow with plastic coaters and automobile manufacturers continuing to buy only small lots for spot and nearby delivery. Prices, as a result, are still displaying a very soft tone.

Market checks indicate that current quotations are generally nominal since the general inactivity which has prevailed for many weeks makes it difficult to determine at just what levels most wide fabric constructions are at present.

Heavier weight constructions, however, generally appear to have maintained a firmer tone recently due to the fact that plastic coaters and other users of these goods are showing more interest in these types.

Vinyl Fabric Growth

In 1956, the vinyl fabric industry showed wholesome signs of maturing, according to Benjamin Messing, president of the Jason Corp., who states that it is not overly optimistic to feel that in 1957 the industry will make the transition from an awkward boom to stable growth.

Underlying today's more favorable attitude toward vinyls is the development of new fabricating techniques, utilizing the modern technology of high speed automation. This makes possible new materials with dramatic qualities of utility and style, Mr. Messing observed.

With these new materials, the industry was able to extend its penetration into the standard markets and open new ones. Leading the way was the rapid expansion in the use of laminates. Laminates have moved into the automobile and seat cover industries and, in large part, took over the field. It should be noted that of the approximately 154,000,000 pounds of vinyl film and sheeting used in 1956, more than 10,000,000 pounds went into laminates.

Entry Into Other Fields

Other fields have felt the impact of vinyl laminates in the form of new decorative supported vinyl fabrics which are finding use in baby carriages, outdoor furniture, schools bags, etc. These fabrics feature exceptionally high strength characteristics and reversible construction. The fabrics are scuff and stain resistant, waterproof, and can be wiped clean with a damp cloth.

(Prices f.o.b. Shipping Point)

Rayon Tire Cord

1100	lb.	.73
1650	lb.	.67
2200	lb.	.67½

Nylon Tire Cord

210	lb.	1.95
840	lb.	1.80

Rayon Graded Fabric

100	lb.	.69
1650	lb.	.63½
2200	lb.	.63

Cotton Chafers

14.4 oz. (per square yard)	lb.	.73
9.25 oz. (per square yard)	lb.	.68
11.65 oz. (per square yard)	lb.	.64
8.9 oz. (per square yard)	lb.	.70

Liquid Latex

Natural: Figures available from the U. S. Department of Commerce show that 72,013 long tons of hevea latex were imported into the United States in 1956, about 16,000 long tons less than were imported in the previous year. Last year, the Commerce Department figures show, 74,082 long tons of hevea latex were consumed in the United States, against the 86,390 long tons consumed in 1955. As of December 31, 1956, there were 12,064 long tons of natural rubber latex on hand, while at the end of the previous year there were 13,203 long tons on hand.

Preliminary figures from the Rubber Manufacturers Association show that 4,958 long tons of hevea latex were imported in January, 1957, and 4,708 long tons consumed. In January of 1956, 10,328 were imported and 6,776 long tons consumed. Hevea latex is currently selling for about 37-38c per pound in car load lots at East Coast ports.

Synthetic: As for GR-S type latex, 69,187 long tons were produced in 1956 and 62,762 long tons consumed. In the previous year, 68,561 long tons were produced and 63,962 long tons consumed. The figures for neoprene latex show that 10,642 long tons were produced in 1956 against the 10,432 long tons produced in the previous year. Consumption figures indicate that 8,708 long tons were consumed in 1956, compared with 8,736 long tons in the previous year.

A total of 10,650 long tons of nitrile latex were produced in 1956, against the 10,798 long tons produced in the preceding year. Nitrile latex consumed in 1956 totaled 8,021 long tons, while in the previous year, 8,495 long tons were consumed in the United States.

Cotton

The price of middling uplands on the New York Cotton Exchange has moved in a range of only 30 points since our last report (January 31), high for the period being 35.55c reached on February 8 and 13, and low being 35.25c reached on February 1, 19 and 27. The average price of spot cotton for the month of February was 34.82c based on 18 trading days. This was also the average in the previous month.

Legislation designed to stabilize extra long staple cotton prices by releasing 50,000 bales from the general stockpile is now awaiting consideration by the Senate Armed Services Committee. The National Cotton Council has urged the office of Defense Mobilibation to release some domestic extra long staple cotton from the stockpile as a stabilizing influence on prices until the new crop becomes available.

Meanwhile, Senator Allen Ellender (Dem., La.) has introduced a bill to stimulate overseas disposal of surplus cotton for foreign currencies. The bill would extend the present law to June 30, 1958, and boost the loan authority by $1,000,000,000 to $4,000,000,000. The new bill would also repeal the section of the law which bans barter or exchange transactions of surplus cotton with European Communist nations.

A House Agriculture subcommittee has recommended, meanwhile, that the Department of Agriculture assure foreign traders it intends to offer from 5,000,000 to 6,000,000 bales of cotton annually in the world market at competitive prices.

STATISTICS of the industry

PERTINENT INDUSTRY DATA

Natural Rubber in the United States

(Including Latex and Guayule)

(All Quantities in Long Tons)

Year	New Supply	Consumption	Re-Exports	Stocks On Hand at End of Period
1931	501,788	355,200	25,609	322,000
1932	414,668	336,700	20,937	379,000
1933	418,902	412,400	20,576	365,000
1934	463,018	462,500	23,856	355,000
1935	467,146	495,500	11,391	303,000
1936	488,145	575,000	12,582	223,000
1937	600,479	543,600	7,902	262,204
1938	411,983	437,031	5,652	231,500
1939	499,473	592,000	13,125	125,800
1940	818,243	648,500	7,060	288,864
1941	1,029,007	775,000	5,376	533,344
1942	282,653	376,791	10,856	422,714
1943	55,329	317,634	20,815	139,594
1944	107,834	144,113	9,665	93,650
1945	135,672	105,429	6,743	118,715
1946	400,687	277,597	4,338	237,467
1947	688,354	562,661	4,101	129,038
1948	735,227	627,332	6,673	141,541
1949	660,792	574,522	6,253	106,619
1950	802,249	720,268	8,644	89,215
1951	733,048	454,015	2,603	76,569
1952	805,997	453,846	3,024	95,260
1953	647,150	553,473	8,376	112,316
1954	596,848	596,285	7,443	104,543
1955	635,174	634,800	10,611	110,105
1956	580,510	563,095	11,300	115,949
1955:				
Dec.	50,556	48,565	986	109,854
1956:				
Jan.	58,803	53,551	1,877	111,943
Feb.	53,353	50,285	752	111,832
Mar.	52,749	50,040	505	108,974
Apr.	51,394	47,446	731	109,822
May	39,789	48,342	753	107,324
June	36,694	42,845	865	101,748
July	41,195	38,353	712	103,301
Aug.	40,367	46,091	759	97,967
Sept.	42,974	44,179	1,184	98,069
Oct.	52,638	52,188	1,543	94,508
Nov.	49,757	42,946	707	106,316
Dec.	57,653	45,227	912	115,949

Source: U. S. Department of Commerce.

U. S. Imports of Natural Rubber

Year	Dry: Long Tons	Dry: Declared Value	Latex: Long Tons	Latex: Declared Value	Total Imports
1935	453,134	115,299,448	13,553	3,782,222	466,687
1936	467,064	152,072,496	19,852	6,659,899	486,916
1937	574,600	237,307,041	23,185	10,213,670	597,785
1938	397,640	125,373,864	11,944	4,168,127	409,584
1939	469,946	167,586,780	27,437	10,467,552	497,383
1940	781,202	303,308,823	33,789	14,593,466	814,991
1941	989,498	401,976,317	34,797	15,965,627	1,024,245
1942	266,276	112,537,426	10,646	5,630,667	276,922
1943	50,358	31,369,198	1,890	1,312,202	52,248
1944	103,847	73,908,549	3,091	2,092,211	106,938
1945	134,408	95,814,102	4,773	3,115,853	139,181
1946	376,502	228,796,110	8,421	5,843,085	384,923
1947	691,087	306,951,814	17,542	9,787,722	708,629
1948	702,293	290,849,177	32,745	18,288,223	735,038
1949	630,808	225,343,624	29,743	14,968,650	660,551
1950	747,109	416,222,598	54,401	41,764,486	801,510
1951	677,874	727,343,348	54,963	80,178,309	732,837
1952	756,987	578,179,519	48,228	40,563,116	805,215
1953	571,635	284,909,223	75,511	46,353,333	647,146
1954	522,364	219,098,143	74,483	42,755,029	596,847
1955	542,507	360,435,303	92,825	80,163,114	635,332
1955:					
Nov.	43,423	34,989,275	7,085	8,063,930	50,508
Dec.	41,759	34,512,483	6,436	6,853,858	48,195
1956:					
Jan.	48,476	38,397,341	10,328	10,355,488	58,804
Feb.	45,682	35,983,385	7,670	7,814,076	46,449
Mar.	44,947	35,238,125	7,791	7,507,686	52,738
Apr.	44,443	31,826,631	6,996	6,369,348	51,439
May	34,058	22,579,829	5,731	4,782,907	39,789
June	31,687	19,375,943	5,006	3,732,281	36,693
July	37,673	22,164,793	3,522	2,539,365	41,195
Aug.	35,652	19,703,676	4,715	3,277,700	40,367
Sept.	40,184	23,453,972	2,790	2,207,011	42,974
Oct.	40,690	28,494,068	5,738	4,341,172	46,428
Nov.	44,995	26,695,282	4,761	3,698,504	49,756

Source: Bureau of the Census, U. S. Department of Commerce.

World Production of Natural Rubber

(Including Latex)

(Long Tons)

Year	Malaya	Indonesia	Ceylon	Viet Nam & Cambodia	Latin America	Rest of World*	Total*
1945	8,600*	10,000*	97,500	12,000*	47,125	73,570	250,000
1946	403,719	175,000*	94,000	19,975	39,678*	105,080	837,500
1947	646,362	277,951	89,000	38,128	34,928*	172,782	1,260,000
1948	698,189	432,349	95,000	43,935	29,158*	225,557	1,525,000
1949	671,503	432,996	89,500	43,010	27,318*	225,659	1,490,000
1950	694,090	696,472	113,500	48,482	26,902*	280,299	1,860,000
1951	605,346	814,406	105,000	52,136	29,777*	278,262	1,885,000
1952	584,238	750,494	96,500	63,134	35,475*	261,211	1,790,000
1953	574,390	692,164	98,610	74,545	35,318*	250,182	1,725,000
1954	584,435	738,670	93,935	78,024	26,833*	280,112	1,802,500
1955	639,128	733,786	93,830	80,172	6,000*	344,584	1,897,500
1956:							
Apr.	48,394	66,164	6,678	5,117	3,447*	25,200	155,000
May	43,224	56,369	7,156	7,222	500*	23,029	137,500
June	52,653	47,831	6,557	7,139	1,527	29,313	145,000
July	54,685	62,715	10,503	8,146	2,830*	23,121	162,000
Aug.	53,277	84,294	9,101	8,450	1,969*	25,409	182,500
Sept.	52,033	50,223	7,600	6,989	2,286*	25,869	145,000
Oct.	52,991	56,052	7,885	9,182	500*	35,890	162,500
Nov.	49,688	66,236	9,717	....	500*	41,359	167,500

Source: International Rubber Study Group. * Estimated.

World Consumption of Natural and Synthetic Rubber

(Including Latex)

(Long Tons)

Year	United States	United Kingdom	Canada	Europe*	Rest of World*	Total*
1944	710,783	86,977	34,310	132,500	160,690	1,125,000
1945	799,009	91,047	41,836	87,500	108,164	1,127,500
1946	1,039,296	126,770	39,196	145,000	115,804	1,467,500
1947	1,122,327	156,399	61,452	242,500	153,548	1,735,000
1948	1,069,404	196,286	62,121	392,000	182,379	1,902,500
1949	988,903	186,622	56,362	446,500	207,388	1,887,500
1950	1,258,557	222,425	68,695	448,500	287,055	2,285,000
1951	1,214,298	238,101	70,809	476,500	314,941	2,312,500
1952	1,261,413	202,179	67,099	550,000	254,901	2,335,000
1953	1,338,309	211,453	73,394	521,000	343,606	2,500,000
1954	1,233,012	247,612	71,656	544,250	408,094	2,505,000
1955	1,529,699	266,804	84,528	630,000	464,250	2,980,000
1956:						
Apr.	122,128	21,991	7,963	60,000	40,918	252,500
May	124,738	17,670	8,157	68,750	34,685	255,000
June	111,454	19,698	7,658	77,750	33,940	250,000
July	96,549	17,565	6,831	63,000	39,305	222,500
Aug.	119,237	12,559	6,375	50,500	38,829	227,500
Sept.	113,384	17,665	7,644	60,750	45,557	245,000
Oct.	134,211	22,887	8,603	65,250	36,549	267,500
Nov.	114,735	19,503	8,598	.....	114,664	257,500

Source: International Rubber Study Group. * Estimated.

Rim Production

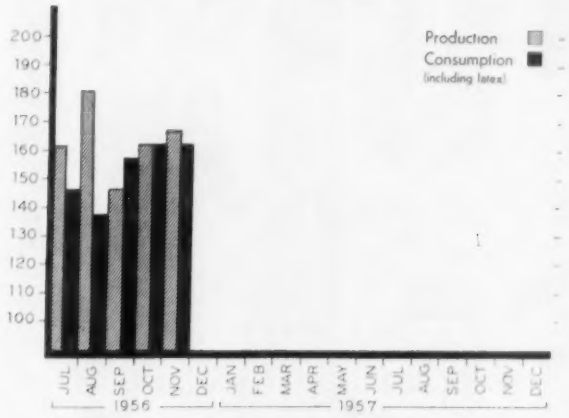
	1952	1953	1954	1955	1956
Passenger Car	24,936,844	31,318,461	25,952,322	38,092,080	27,109,610
Truck & Bus	5,752,674	5,228,321	4,463,689	6,642,329	6,315,428
Agricultural	2,073,116	1,943,487	1,297,040	1,931,768	1,416,938
Earth Mover	31,791	24,685	21,536	38,859	88,812
Total	32,794,425	38,514,954	31,734,587	46,705,036	34,930,788

	1956 Aug.	Sept.	Oct.	Nov.	Dec.	1957 Jan.
Passenger Car	1,662,478	1,503,720	2,249,790	2,744,187	2,633,768	2,797,268
Truck & Bus	444,204	549,760	563,660	386,557	408,167	468,265
Agricultural	79,190	80,379	93,601	118,435	64,640	157,773
Earth Mover	4,338	12,740	7,949	8,363	8,252	6,857
Total	2,190,210	2,146,599	2,915,000	3,257,542	3,114,827	3,430,163

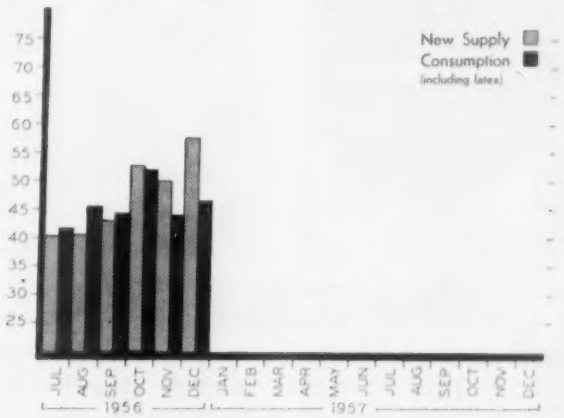
Source: The Tire & Rim Association, Inc.

STATISTICS at a glance

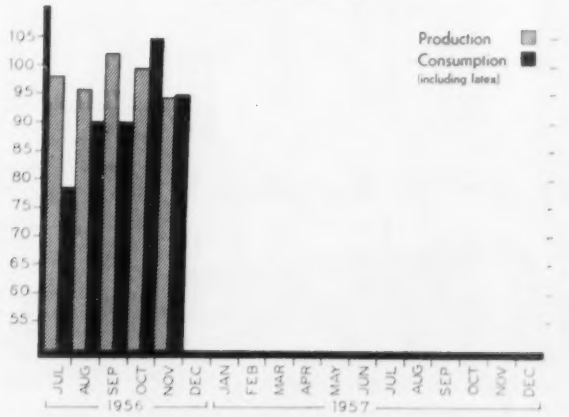
NATURAL RUBBER—WORLD
(thousands of long tons)



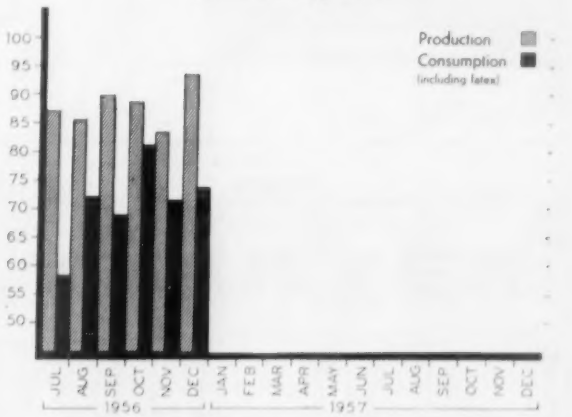
NATURAL RUBBER—UNITED STATES
(thousands of long tons)



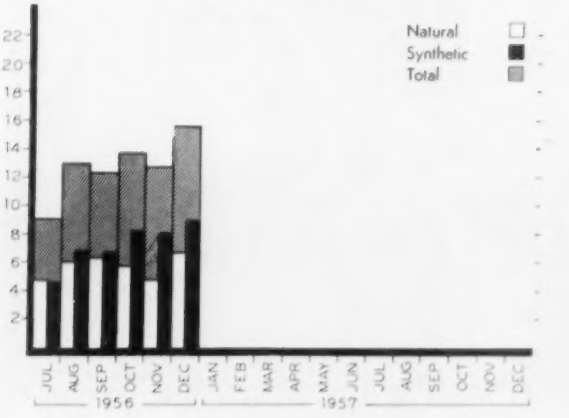
SYNTHETIC RUBBER—WORLD
(thousands of long tons)



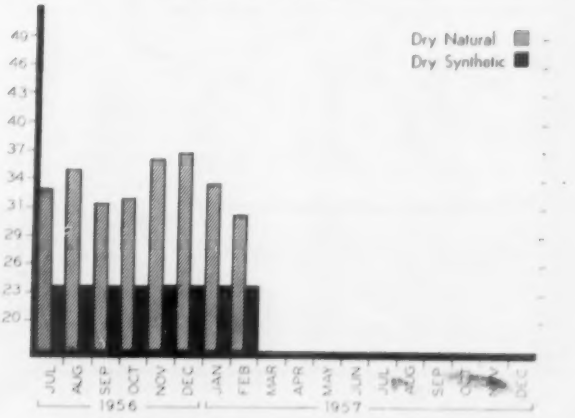
SYNTHETIC RUBBER—UNITED STATES
(thousands of long tons)



LATEX CONSUMPTION—UNITED STATES
(thousands of long tons)



PRICES—NATURAL AND SYNTHETIC
(cents per pound)



Synthetic Rubber in the United States

(All Quantities in Long Tons)

New Supply

Year	GR-S	Neoprene	Butyl	N-Type	Total
1949	310,529	35,215	54,046	11,072	410,932
1950	378,887	50,067	60,915	12,037	501,906
1951	704,529	58,907	76,475	15,333	855,244
1952	654,854	65,745	81,630	16,228	818,447
1953	680,728	80,495	79,801	20,198	861,222
1954	490,405	69,150	58,802	21,396	639,753
1955	801,145	91,357	56,179	32,623	982,304
1956	876,982	99,412	75,873	34,547	1,086,814
1956:					
Jan.	76,028	8,207	6,896	3,125	94,256
Feb.	73,457	8,560	6,229	2,989	91,235
Mar.	77,812	7,822	5,686	3,663	94,983
Apr.	74,502	8,481	5,685	3,648	92,316
May	78,309	7,795	5,647	2,903	94,654
June	69,820	8,929	4,638	2,350	85,737
July	70,831	7,935	7,192	2,460	88,418
Aug.	70,122	7,769	7,118	2,125	87,134
Sept.	73,321	8,328	7,252	2,322	91,223
Oct.	70,690	8,144	7,018	2,973	88,825
Nov.	66,482	8,614	6,065	3,092	84,253
Dec.	75,608	6,828	6,447	2,881	93,764

Consumption

1950	416,230	43,781	66,348	11,930	538,289
1951	626,444	48,887	70,500	13,066	758,897
1952	666,420	55,522	71,229	13,866	807,037
1953	624,181	65,900	77,826	16,929	784,836
1954	500,345	57,203	61,464	17,715	636,727
1955	741,997	72,876	53,991	26,035	894,899
1956	727,789	74,887	49,615	24,976	877,267
1956:					
Jan.	65,375	6,684	4,223	2,198	78,480
Feb.	62,366	6,430	4,155	2,289	75,240
Mar.	64,458	6,542	4,515	2,373	77,888
Apr.	62,179	6,125	4,228	2,150	74,682
May	63,629	6,379	4,285	2,103	76,396
June	56,390	5,536	4,026	1,864	67,816
July	48,907	4,435	3,316	1,538	58,196
Aug.	59,756	6,554	4,102	2,125	72,537
Sept.	57,135	6,057	4,044	1,969	69,205
Oct.	67,399	7,478	4,780	2,366	82,023
Nov.	58,692	6,676	4,093	2,065	71,526
Dec.	61,503	5,991	3,848	1,936	73,278

Exports

1949	1,401	3,330	178	1,574	6,483
1950	900	4,826	31	1,895	7,652
1951	483	6,825	216	1,725	9,249
1952	9,467	9,813	126	2,695	22,101
1953	7,692	11,494	237	3,245	22,668
1954	11,069	12,062	2,831	4,155	30,117
1955	60,704	18,098	9,895	4,593	93,290
1956:					
Jan.	7,550	1,757	815	506	10,628
Feb.	9,018	1,521	1,624	449	12,612
Mar.	10,804	1,500	764	522	13,590
Apr.	10,271	1,917	374	587	13,149
May	10,864	2,142	743	443	14,192
June	9,310	2,088	746	548	12,692
July	9,038	1,994	523	433	11,988
Aug.	9,607	2,268	654	274	12,803
Sept.	8,804	2,824	439	403	12,470
Oct.	6,795	1,013	454	618	8,880
Nov.	4,789	1,056	247	551	6,643

Stocks

1949	77,731	4,654	12,224	3,433	98,042
1950	36,947	5,733	7,243	2,840	52,758
1951	105,271	8,379	12,481	3,821	129,912
1952	83,861	8,535	22,716	3,875	118,987
1953	135,153	11,480	24,866	4,346	175,845
1954	115,499	11,349	19,267	4,280	150,395
1955	108,989	12,220	10,500	6,030	137,739
1956	151,763	14,077	28,744	7,934	202,518
1956:					
Jan.	111,263	11,850	12,303	6,316	141,732
Feb.	114,389	11,888	13,027	6,602	145,906
Mar.	118,063	12,047	13,458	7,437	150,995
Apr.	121,054	12,042	14,071	8,243	155,410
May	127,163	11,478	15,253	8,788	162,682
June	133,570	12,927	15,744	2,086	164,327
July	145,601	15,084	18,899	2,009	181,593
Aug.	148,176	14,540	21,267	8,503	192,486
Sept.	154,841	14,055	23,862	8,035	200,793
Oct.	151,646	12,841	25,734	7,567	197,788
Nov.	151,143	13,459	26,998	7,734	199,334
Dec.	151,763	14,077	28,744	7,934	202,518

Source: U. S. Department of Commerce.

Natural and Synthetic Rubber Latex in the United States

(All Quantities in Long Tons)

New Supply

Year	Natural	GR-S	Neoprene	N-Type	Total Synthetic	Grand Total
1945	4,768	15,176	7,077	.....	22,253	27,021
1946	8,012	24,810	13,595	.....	38,405	46,417
1947	17,675	22,474	6,089	.....	28,563	46,238
1948	32,630	21,494	5,022	.....	26,516	59,146
1949	29,974	21,357	3,651	.....	25,008	54,982
1950	54,401	31,339	5,725	.....	37,064	91,465
1951	54,963	32,972	6,866	2,948	42,786	97,749
1952	48,228	42,273	7,598	4,164	54,035	102,263
1953	75,511	48,112	9,026	5,844	62,982	138,493
1954	74,483	48,379	8,214	6,866	63,459	137,942
1955	92,754	69,364	10,432	10,798	90,594	183,348
1956	72,013	69,720	10,642	10,650	91,012	163,025
1955:						
Nov.	7,085	6,933	1,004	781	8,718	15,803
Dec.	6,018	6,407	962	874	8,243	14,261
1956:						
Jan.	10,328	6,885	848	919	8,652	18,890
Feb.	7,965	6,943	930	827	8,700	16,665
Mar.	7,800	5,911	782	1,158	7,851	15,651
Apr.	6,995	6,066	969	866	7,901	14,896
May	5,731	4,966	939	614	6,519	12,250
June	5,006	4,776	907	543	6,226	11,232
July	3,522	4,241	444	731	5,416	8,938
Aug.	4,715	4,902	882	684	6,468	11,183
Sept.	2,790	5,723	1,180	938	7,841	10,631
Oct.	5,738	6,122	908	1,183	8,213	13,951
Nov.	4,762	6,053	886	1,175	8,114	12,876
Dec.	6,661	7,101	967	1,012	9,080	15,741

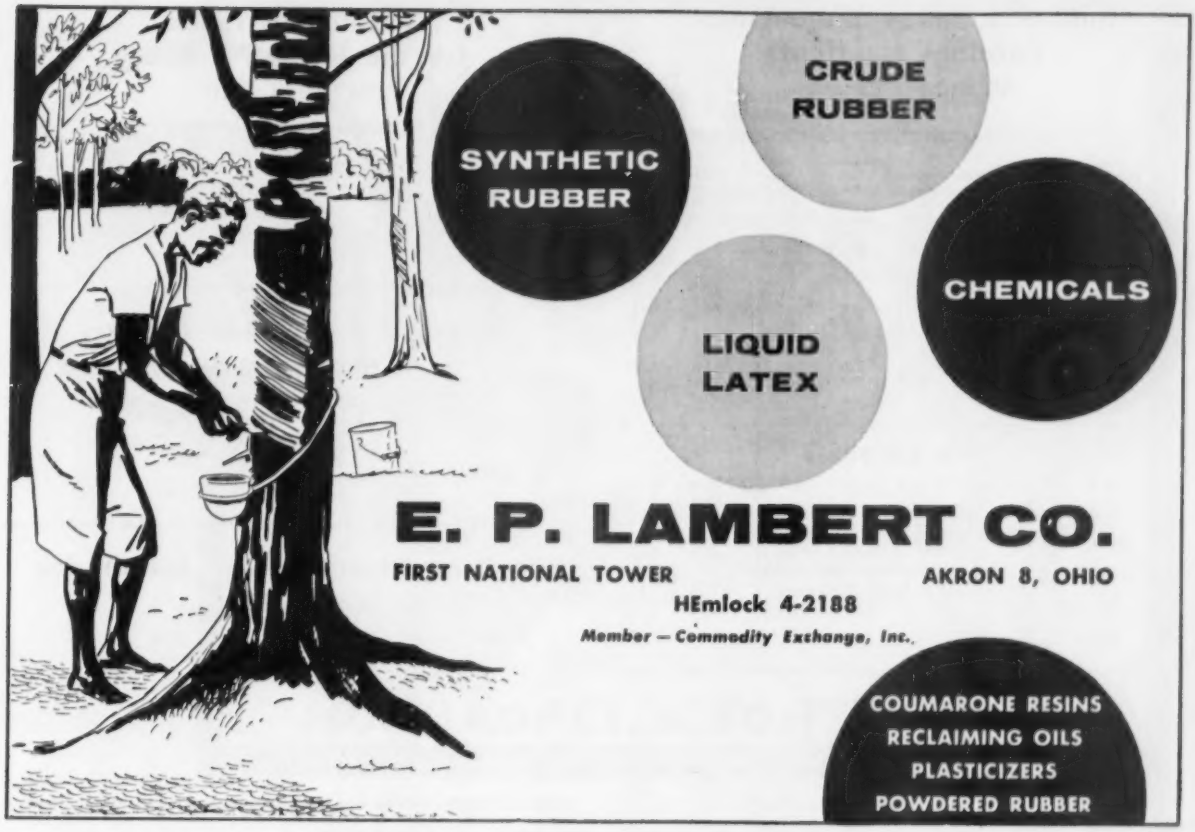
Consumption[1]

1945	3,886	14,500	6,800	.....	21,300	25,186
1946	5,714	23,500	13,000	.....	36,500	42,214
1947	13,909	22,500	6,500	.....	29,000	42,909
1948	28,489	21,500	5,250	.....	26,750	55,239
1949	26,117	21,500	3,750	.....	25,250	61,367
1950	56,138	31,000	5,500	.....	36,500	92,638
1951	46,750	31,031	6,279	2,628	39,938	86,688
1952	53,567	40,562	7,368	3,093	51,023	104,590
1953	67,375	46,473	7,981	3,654	58,108	125,483
1954	75,931	44,173	7,251	4,507	55,931	131,862
1955	86,478	63,982	8,736	8,495	81,213	167,691
1956	74,082	62,762	8,708	8,021	79,491	153,573
1955:						
Nov.	6,620	5,954	829	603	7,386	14,006
Dec.	6,473	5,719	768	538	7,025	13,498
1956:						
Jan.	6,776	5,858	772	670	7,300	14,076
Feb.	6,399	5,913	787	730	7,430	13,829
Mar.	6,438	5,888	729	781	7,398	13,836
Apr.	5,693	4,923	741	692	6,356	12,049
May	5,239	4,745	778	691	6,214	11,453
June	5,171	4,350	637	657	5,644	10,815
July	4,855	3,731	562	466	4,759	9,614
Aug.	6,374	5,055	816	698	6,569	12,943
Sept.	6,233	4,937	692	699	6,328	12,561
Oct.	7,825	6,175	795	681	7,651	15,476
Nov.	6,431	5,406	723	659	6,788	13,219
Dec.	6,648	5,781	676	597	7,054	13,702

Stocks at End of Period

1945	3,121	....	....	....	....	3,121
1946	4,865	....	....	....	....	4,865
1947	5,033	....	....	....	....	5,033
1948	11,235	....	....	....	....	11,235
1949	5,063	....	....	....	....	5,063
1950	4,927	....	....	....	....	4,927
1951	4,752	3,727	1,245	532	5,504	10,256
1952	6,201	5,040	1,019	902	6,961	13,162
1953	13,532	4,794	1,117	721	6,632	20,164
1954	11,133	5,134	1,087	811	7,032	18,165
1955	13,203	6,980	1,236	1,807	10,203	23,406
1956	12,064	7,451	1,384	1,558	10,393	22,457
1955:						
Nov.	12,616	6,307	1,089	1,174	8,570	21,186
Dec.	12,645	6,357	1,155	1,248	8,760	21,405
1956:						
Jan.	16,059	6,522	1,093	1,906	9,521	25,580
Feb.	16,735	7,011	1,162	1,943	10,116	26,851
Mar.	18,309	6,867	1,097	2,340	10,304	28,613
Apr.	21,384	7,415	1,163	2,272	10,850	32,234
May	21,234	7,516	1,218	2,194	10,928	32,162
June	21,033	7,447	1,328	2,086	10,861	31,894
July	19,952	7,288	1,109	2,009	10,406	30,358
Aug.	18,099	6,402	1,076	1,703	9,181	27,280
Sept.	15,403	6,625	1,328	1,523	9,476	24,879
Oct.	12,322	5,703	1,263	1,680	8,646	20,968
Nov.	11,148	6,282	1,233	1,939	9,454	20,602
Dec.	12,064	7,451	1,384	1,558	10,393	22,457

Source: U. S. Department of Commerce.
Note: (1) GR-S and Neoprene consumption estimated through 1950.



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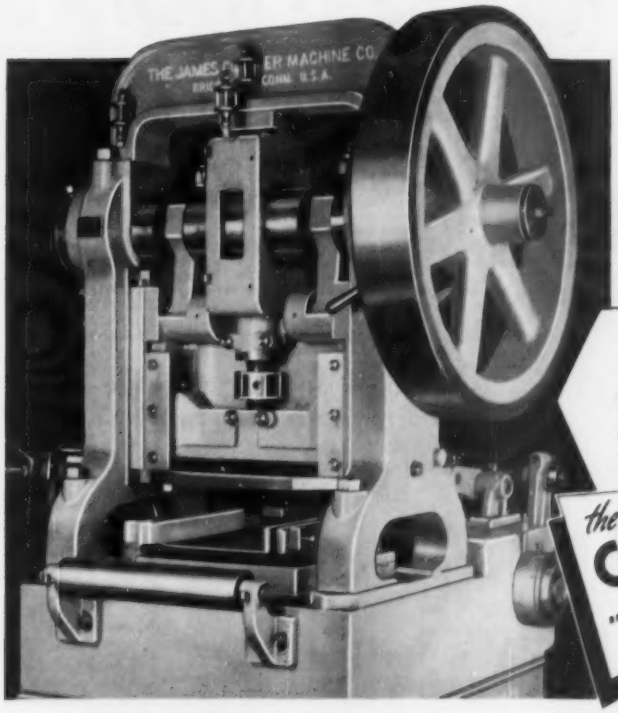

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Rubber Industry Employment Earnings and Hours

All Rubber Products

Mo.	1955 Production Workers (thousands)	1955 Average Weekly Earnings	1955 Average Weekly Hours	1955 Average Hourly Earnings	1956 Production Workers (thousands)	1956 Average Weekly Earnings	1956 Average Weekly Hours	1956 Average Hourly Earnings
Jan.	208.5	$83.84	41.3	$2.03	229.5	$87.91	40.7	$2.16
Feb.	209.4	84.25	41.3	2.04	224.5	85.81	40.1	2.14
Mar.	211.6	83.64	41.0	2.04	220.8	84.93	39.5	2.15
Apr.	210.9	86.53	41.8	2.07	218.7	85.79	39.9	2.15
May	215.7	87.36	42.0	2.08	216.0	86.18	39.9	2.16
June	219.0	88.83	42.3	2.10	208.5	84.93	39.5	2.15
July	215.7	86.32	41.3	2.09	208.0	86.15	39.7	2.17
Aug.	216.8	86.32	41.3	2.09	210.8	87.64	40.2	2.18
Sept.	223.1	86.74	41.5	2.09	215.4	89.51	40.5	2.21
Oct.	226.4	89.04	42.0	2.12	220.5	90.17	40.8	2.21
Nov.	231.2	92.01	42.4	2.17	207.6	....	....	....
Dec.	233.9	89.21	41.3	2.16	....	....	....	....
Tires and Tubes								
Jan.	85.3	97.41	41.1	2.37	93.7	101.00	40.4	2.50
Feb.	86.5	96.46	40.7	2.37	93.2	97.71	39.4	2.48
Mar.	87.4	95.51	40.3	2.37	92.6	97.25	38.9	2.50
Apr.	88.6	102.18	42.4	2.41	91.8	98.00	39.2	2.50
May	89.8	101.88	42.1	2.42	91.6	99.65	39.7	2.51
June	91.0	105.60	43.1	2.45	90.1	98.25	39.3	2.50
July	91.5	103.33	42.7	2.42	90.0	98.14	39.1	2.51
Aug.	91.0	102.72	42.1	2.44	89.8	101.20	40.0	2.53
Sept.	91.9	101.02	41.4	2.44	91.6	102.51	40.2	2.55
Oct.	92.3	103.74	42.0	2.47	91.8	102.91	40.2	2.56
Nov.	94.2	106.26	42.0	2.53	....	....	....	....
Dec.	94.7	99.50	39.8	2.50	....	....	....	....
Rubber Footwear								
Jan.	22.1	68.97	40.1	1.72	21.0	74.37	40.2	1.85
Feb.	21.5	69.72	40.3	1.73	20.9	74.74	40.4	1.85
Mar.	21.5	69.72	40.3	1.73	20.7	71.34	39.2	1.82
Apr.	21.3	70.82	40.7	1.74	20.3	72.25	39.7	1.82
May	21.3	70.07	40.5	1.73	20.0	72.25	39.7	1.82
June	21.6	71.34	41.0	1.74	19.4	70.53	39.4	1.79
July	21.8	70.99	40.8	1.74	18.9	71.28	39.6	1.80
Aug.	21.5	67.25	39.1	1.72	19.2	70.35	39.3	1.79
Sept.	23.5	67.60	39.3	1.72	19.3	71.71	39.4	1.82
Oct.	24.4	69.20	40.0	1.73	19.2	71.71	39.4	1.82
Nov.	25.5	77.89	42.1	1.85	....	....	....	....
Dec.	26.2	74.89	40.7	1.84	....	....	....	....
All Other Rubber Products								
Jan.	101.1	76.08	41.8	1.82	114.8	79.73	41.1	1.94
Feb.	101.4	76.86	42.0	1.83	110.4	77.95	40.6	1.92
Mar.	102.7	76.49	41.8	1.83	107.5	76.99	40.1	1.92
Apr.	101.0	76.54	41.6	1.84	106.6	77.95	40.6	1.92
May	104.6	78.68	42.3	1.86	104.4	76.99	40.1	1.92
June	106.4	77.93	41.9	1.86	99.0	76.02	39.8	1.91
July	102.4	74.37	40.2	1.85	99.1	77.78	40.3	1.93
Aug.	104.3	75.85	41.0	1.85	101.8	78.76	40.6	1.94
Sept.	107.7	78.96	42.0	1.88	104.5	81.18	41.0	1.98
Oct.	109.7	80.56	42.4	1.90	109.5	82.78	41.6	1.99
Nov.	111.5	83.03	42.8	1.94	....	....	....	....
Dec.	113.0	83.69	42.7	1.96	....	....	....	....

Source: U. S. Department of Labor.

Note: Data are based upon reports from cooperating establishments covering both full and part-time employees who work during, or received pay for, any part of the pay period ending nearest the 15th of the month. These employment series have been adjusted to first quarter 1954 benchmark levels indicated by data from government social insurance programs. Hours and earnings data pertain only to production and related workers.

Spot Closing Cotton Prices

(Middling Upland Grade—New York Market—in Cents)

Average Monthly Price Per Pound

	1950	1951	1952	1953	1954	1955	1956	1957
Jan.	31.89	45.04	42.96	33.24	34.15	35.07	35.24	34.82
Feb.	32.79	(a)	41.64	33.76	35.00	35.04	36.26	34.82
Mar.	32.65	46.06	41.70	34.10	35.23	34.33	36.70	....
Apr.	33.23	46.06	41.79	33.85	35.22	34.23	36.81	....
May	33.64	46.06	39.98	34.30	35.34	34.80	36.65	....
June	34.61	46.06	41.31	34.11	35.17	34.83	36.67	....
July	38.11	46.21	40.37	34.20	35.37	34.61	35.43	....
Aug.	38.93	35.93	40.42	33.82	35.19	34.53	34.31	....
Sept.	41.62	36.20	39.75	33.69	35.46	33.85	34.35	....
Oct.	40.66	38.13	37.52	33.53	35.24	33.93	34.45	....
Nov.	43.11	42.70	35.59	33.60	34.80	34.87	34.56	....
Dec.	43.37	43.32	33.76	33.52	35.03	34.95	34.56	....
Average for Year	37.05	42.43	39.71	33.81	35.10	34.59	35.50	....

Note: The Government established a ceiling of 45.76c for spot cotton on March 3, 1951. (a) Trading suspended during February.

Production Index for the Rubber Industry

(1947-1949 = 100)

(Based on man-hours)

	1954	1955	1956		1954	1955	1956
Jan.	114	145	147	July	85	137	119
Feb.	114	144	140	Aug.	94	138	132
Mar.	118	146	135	Sept.	118	142	133
Apr.	116	147	137	Oct.	132	147	136
May	121	146	131	Nov.	124	147	126
June	121	149	122	Dec.	128	144	139

Sales by the Rubber Industry

(in Millions of Dollars*)

	1954	1955	1956		1954	1955	1956
Jan.	361	424	415	July	393	471	459
Feb.	360	440	445	Aug.	352	456	436
Mar.	378	466	451	Sept.	346	456	429
Apr.	382	445	445	Oct.	346	447	454
May	378	465	464	Nov.	404	482	...
June	385	465	450	Dec.	417	465	...

Rubber Manufacturers' Inventories

(in Millions of Dollars*)

	1954	1955	1956		1954	1955	1956
Jan.	835	790	935	July	787	853	987
Feb.	848	782	970	Aug.	754	863	1,007
Mar.	844	805	979	Sept.	799	874	1,007
Apr.	813	784	970	Oct.	835	902	1,022
May	798	810	985	Nov.	811	935	...
June	817	850	975	Dec.	821	934	...

Source: U. S. Department of Commerce.
Notes: * Adjusted for seasonal variation.

No. 1 R.S.S.—Annual Average Prices

(New York Market—Cents per Pound)

Year	High	Low	Avg.	Year	High	Low	Avg.
1915	79	58½	65.85	1936	23	13½	16.41
1916	102	55	72.50	1937	26⅜	14	19.39
1917	90	52	72.23	1938	17⅞	10¼	14.64
1918	70	40	60.15	1939	24	14⅛	17.57
1919	57	38½	48.70	1940	24	18¼	20.10
1920	56½	16	36.30	1941	24⅞	19¼	22.40
1921	21¼	11½	16.36	1942	22½	22½	22.50
1922	28⅜	13⅜	17.50	1943	22½	22½	22.50
1923	37½	24¼	29.45	1944	22½	22½	22.50
1924	40⅜	17⅛	26.20	1945	22½	22½	22.50
1925	121	34⅜	72.46	1946	22½	22½	22.50
1926	88½	36¾	48.50	1947	25	14	20.00
1927	41⅜	33	37.72	1948	25	18	21.99
1928	41⅛	17	22.48	1949	19¾	15⅞	17.57
1929	26⅞	15½	20.55	1950	86	18	41.10
1930	16½	7½	11.98	1951	76	52	(a)
1931	8⅝	4⅛	6.17	1952*	33	26½	29.15
1932	4¾	2½	3.49	1953	31⅞	19⅞	24.21
1933	9⅞	2⅛	5.96	1954	34½	19½	23.61
1934	15⅞	8⅜	12.92	1955	52	29⅜	39.16
1935	13¾	10½	12.37	1956	45	26½	34.24

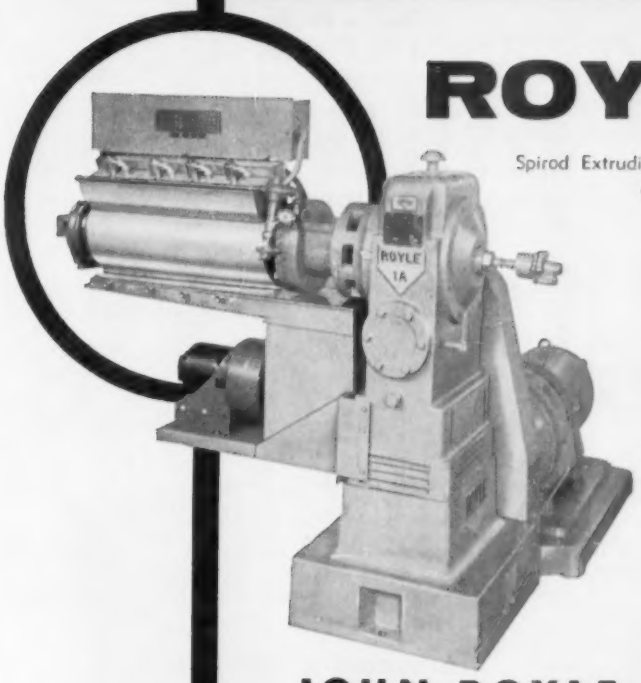
Note: Price was fixed by Government on August 6, 1941, at 22½c a pound for non-war uses. Free trading was resumed May 1, 1947. (a) Free trading suspended March 31, 1951. GSA selling price ranged between 52 and 66c during balance of year. * Free trading was resumed on July 1, 1952; figures represent only July through December, 1952.

No. 1 R.S.S.—Monthly Average Prices

(New York Market—Cents per pound)

	1950	1951	1952	1953	1954	1955	1956	1957
Jan.	18.33	71.21	....	29.40	20.22	33.92	41.70	33.32
Feb.	19.40	73.61	....	27.57	19.98	34.90	33.68	30.43
Mar.	19.86	72.05	....	26.59	20.16	31.08	33.68	....
Apr.	23.51	....	....	24.66	22.06	31.75	31.74	....
May	28.07	....	....	25.52	21.96	31.35	29.61	....
June	30.92	....	....	24.42	23.01	34.74	30.54	....
July	39.10	....	30.52	23.64	24.12	40.84	33.91	....
Aug.	51.63	....	29.36	23.36	23.26	45.85	35.69	....
Sept.	55.98	....	27.42	23.06	23.99	48.27	32.64	....
Oct.	62.19	....	27.26	20.82	26.57	43.81	32.68	....
Nov.	73.05	....	29.25	20.58	28.07	44.95	35.18	....
Dec.	71.20	....	31.26	20.92	29.88	48.40	37.01	....
Average for Year	41.10	(*)	29.15	24.21	23.61	39.16	34.24	....

Note: (*) Free trading suspended March 31, 1951, and resumed on July 1, 1952.



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Automotive Pneumatic Casings

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1949 (total)	31,584	43,466	1,467	76,517	76,369	10,638
Passenger Car.	28,129	36,440	509	65,077	65,140	8,904
Truck and Bus	3,456	7,026	958	11,440	11,228	1,734
1950 (total)	41,349	56,808	1,430	99,587	92,754	3,794
Passenger Car	36,678	47,103	642	84,423	78,598	3,050
Truck and Bus	4,671	9,705	788	15,164	14,156	743
1951 (total)	32,153	44,612	1,677	78,442	83,405	8,765
Passenger Car	26,729	34,226	723	61,678	65,546	6,973
Truck and Bus	5,424	10,386	954	16,764	17,859	1,791
1952 (total)	29,484	54,342	1,520	85,346	90,411	14,110
Passenger Car.	24,106	45,458	741	70,305	74,341	11,251
Truck and Bus	5,378	8,884	779	15,041	16,070	2,859
1953 (total)	37,949	55,124	1,543	94,617	96,150	15,720
Passenger Car.	33,106	45,798	809	79,713	81,455	13,044
Truck and Bus	4,843	9,326	734	14,904	14,696	2,676
1954 (total)	33,333	55,155	1,753	90,241	89,141	14,762
Passenger Car.	29,741	47,044	928	77,713	76,794	12,217
Truck and Bus	3,591	8,111	826	12,528	12,347	2,545
1955 (total)	47,374	59,246	1,879	108,499	112,178	18,778
Passenger Car.	42,574	50,189	966	93,730	97,223	15,963
Truck and Bus	4,800	9,057	912	14,769	14,955	2,815
1956 (total)	35,422	62,146	1,757	99,325	100,406	79,872
Passenger Car.	30,873	53,252	875	85,000	85,546	16,494
Truck and Bus	4,548	8,894	883	14,325	14,859	3,378
1956:						
Jan. (total)	3,402	4,669	131	8,203	8,979	19,517
Passenger Car.	2,958	4,040	66	7,064	7,661	16,546
Truck and Bus	444	629	65	1,139	1,318	2,971
Feb. (total)	3,342	3,952	178	7,473	8,897	20,933
Passenger Car.	2,919	3,387	90	6,396	7,571	17,701
Truck and Bus	424	565	88	1,077	1,326	3,232
Mar. (total)	3,466	5,034	127	8,627	9,193	21,562
Passenger Car.	3,027	4,372	65	7,464	7,812	18,096
Truck and Bus	439	662	62	1,163	1,382	3,465
Apr. (total)	3,217	5,761	141	9,119	8,834	21,132
Passenger Car.	2,787	4,994	67	7,847	7,530	17,649
Truck and Bus	430	767	74	1,271	1,303	3,483
May (total)	2,770	5,980	130	8,880	8,986	21,296
Passenger Car.	2,349	5,203	65	7,617	7,628	17,714
Truck and Bus	421	777	65	1,264	1,358	3,582
June (total)	2,533	6,627	129	9,289	7,929	19,947
Passenger Car.	2,162	5,659	64	7,885	6,600	16,443
Truck and Bus	372	968	65	1,404	1,329	3,503
July (total)	2,833	6,319	145	9,298	6,741	17,394
Passenger Car.	2,471	5,482	73	8,026	5,668	14,088
Truck and Bus	362	837	72	1,271	1,073	3,306
Aug. (total)	2,302	6,178	163	8,644	8,050	16,794
Passenger Car.	1,953	5,359	77	7,389	6,897	13,578
Truck and Bus	349	819	86	1,254	1,153	3,217
Sept. (total) ...	1,553	5,238	162	6,952	7,800	17,648
Passenger Car.	1,261	4,427	70	5,758	6,647	14,468
Truck and Bus	291	811	92	1,194	1,153	3,180
Oct. (total) ..	2,908	4,703	165	7,776	8,799	18,775
Passenger Car.	2,530	3,854	87	6,471	7,526	15,607
Truck and Bus	378	849	78	1,305	1,273	3,168
Nov. (total)	3,516	3,881	121	7,518	7,641	18,803
Passenger Car.	3,179	3,255	62	6,496	6,580	15,596
Truck and Bus	337	626	59	1,022	1,060	3,207
Dec. (total)	3,579	3,803	166	7,548	8,556	19,872
Passenger Car.	3,277	3,220	90	6,587	7,425	16,494
Truck and Bus	301	583	76	961	1,130	3,378

Source: The Rubber Manufacturers Association, Inc.

Automobile Production in U. S.

(Civilian Production Only)

Year	Passenger Cars	Trucks	Total	Year	Passenger Cars	Trucks	Total
1937	3,915,889	892,382	4,808,271	1947	3,558,178	1,220,634	4,778,812
1938	2,000,985	485,852	2,486,837	1948	3,909,270	1,363,856	5,273,126
1939	2,866,796	704,308	3,571,104	1949	5,108,841	1,123,736	6,232,577
1940	3,692,328	721,637	4,413,965	1950	6,665,836	1,332,263	7,998,099
1941	3,744,500	875,381	4,619,681	1951	5,337,729	1,420,432	6,758,161
1942	220,814	133,083	353,897	1952	4,320,794	1,212,790	5,533,584
1943	0	4,501	4,501	1953	6,121,787	1,202,196	7,323,983
1944	0	124,819	124,819	1954	5,558,897	1,038,045	6,596,942
1945	83,792	313,643	397,435	1955	7,920,186	1,245,018	9,165,204
1946	2,148,699	930,760	3,079,429	1956	5,816,109	1,100,417	6,916,526
1955:							
Jan.	635,513	89,676	725,189	July	658,736	109,589	768,325
Feb.	677,705	67,061	744,766	Aug.	620,610	95,119	715,729
Mar.	791,280	102,992	894,272	Sept.	467,845	91,894	559,739
Apr.	753,434	127,887	881,321	Oct.	505,177	95,610	600,787
May	721,139	127,941	849,080	Nov.	745,993	114,448	860,441
June	647,658	119,215	766,873	Dec.	695,096	103,586	799,092
1956:							
Jan.	591,032	98,968	690,000	July	440,980	80,731	521,711
Feb.	560,924	102,384	663,308	Aug.	417,020	85,827	502,847
Mar.	583,169	106,379	689,548	Sept.	203,888	71,299	275,187
Apr.	552,881	101,081	653,962	Oct.	352,140	92,684	444,824
May	474,010	96,114	570,124	Nov.	576,708	90,246	666,954
June	445,758	91,791	537,549	Dec.	617,599	82,913	700,512

Source: Automobile Manufacturers Association.
Note: Figures are based on factory sales. Revisions are made from time to time in these figures and the latest issue should be consulted for accuracy.

Automotive Inner Tubes

(Thousands of Units)

	Shipments					
Year	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1946	15,327	59,357	1,424	76,108	77,251	3,820
1947	25,046	46,560	2,483	74,088	79,181	8,059
1948	26,833	40,548	1,119	68,499	70,033	9,641
1949	31,521	31,450	887	63,858	65,114	10,657
1950	41,240	42,671	811	84,723	80,179	....
1951	32,151	32,284	1,071	65,507	67,249	10,094
1952	29,451	32,985	1,014	63,449	65,073	12,036
1953	37,957	36,072	878	74,907	74,425	11,874
1954	25,071	35,576	945	61,593	48,279	9,519
1955	5,001	33,387	1,001	39,389	35,900	6,833
1956	3,100	32,358	1,040	36,498	34,405	6,109
1956:						
Apr.	265	2,444	88	2,797	3,094	7,312
May	280	2,515	83	2,878	3,093	7,657
June	269	3,023	79	3,370	2,837	7,349
July	247	3,055	82	3,384	2,300	6,418
Aug.	242	2,954	99	3,295	2,795	5,962
Sept.	213	2,472	91	2,777	2,773	6,056
Oct.	261	2,518	98	2,877	3,025	6,469
Nov.	259	2,468	65	2,792	2,585	6,250
Dec.	235	2,515	87	2,837	2,670	6,109

Source: The Rubber Manufacturers Association, Inc.

Vinyl and Vinyl Copolymer Resins—Sales

(Thousands of Pounds—Resin Content)

	Polyvinyl Chloride and Copolymer Resins							All Other Vinyl Resins		
	Film	Sheeting	Molding & Extrusion	Textile & Paper Treating	Flooring	Protective Coatings	All Other Uses	Adhesives	All Other Uses	Grand Total
1953	63,691	62,385	129,215	52,353	22,152	22,823	27,790	22,411	77,478	480,299
1954	69,943	56,588	147,284	49,546	34,890	23,676	35,148	26,609	74,090	517,773
1955	83,276	51,424	183,736	64,223	56,357	27,439	53,868	31,853	105,644	657,821
1956	78,063	55,598	206,726	62,931	65,384	28,522	71,859	36,565	115,151	720,799
1955:										
Nov.	6,855	4,771	18,224	6,271	4,945	2,147	6,818	2,945	9,831	62,807
Dec.	6,273	4,585	16,682	6,089	4,214	1,980	5,458	2,190	10,087	57,558
1956:										
Jan.	6,496	4,928	16,842	6,176	5,181	2,289	6,584	3,331	10,628	62,455
Feb.	6,849	5,296	16,509	5,187	4,894	1,792	6,185	2,718	8,696	58,126
Mar.	7,388	5,280	16,965	4,962	5,016	2,274	5,811	3,162	9,364	60,222
Apr.	6,247	4,674	15,560	4,646	4,494	2,344	7,295	3,114	11,612	59,986
May	5,948	4,403	16,470	4,322	5,075	2,458	6,087	3,288	10,158	58,209
June	5,345	4,217	14,946	4,727	5,316	2,364	5,228	2,863	7,731	52,737
July	4,722	3,714	15,203	4,298	4,231	2,681	2,321	3,165	8,146	48,481
Aug.	6,497	4,787	17,490	5,727	6,798	2,416	7,228	3,256	9,213	63,412
Sept.	7,159	4,194	17,228	5,198	5,526	2,025	5,945	2,893	9,291	59,458
Oct.	8,581	5,341	21,339	6,384	6,790	2,568	5,984	3,231	10,773	70,992
Nov.	7,002	4,774	19,895	5,888	6,253	2,639	6,128	3,115	10,242	65,936
Dec.	5,829	3,990	18,279	5,416	5,810	2,672	7,063	2,429	9,297	60,785

Source: Chemical Division, U. S. Tariff Commission.

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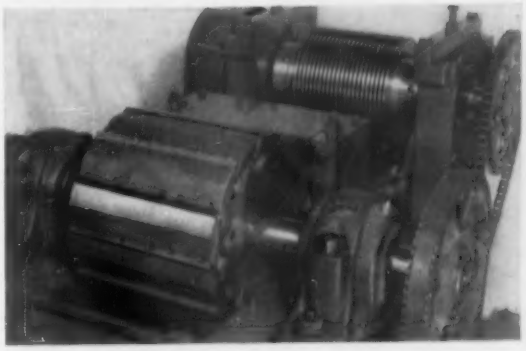

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Various Compounding Materials Consumed by the Rubber Industry

Material	1949	1950	1951	1952	1953	1954	1955
Antimony, Primary:							
Short tons	55	103[c]	19[c]	66[c]	20[c]	49[c]	45[c]
% of total	.005	.007	.001	.004	.001	.004	.004
Asphalt:[a]							
Short tons	18,050	26,819	21,414	33,288	.....	.....	.....
% of total	0.3	0.3	0.3	0.4	.....	.....	.....
Barite (Barytes):							
Short tons	14,000	19,000	15,000	18,000	21,000	20,000	....
% of total	2.53	3.31	2.13	2.0	2.0	2.0	....
Carbon Black:							
Short tons	383,565	515,184	530,614	537,273	566,797	511,813	.....
% of total	93.3	92.9	93.9	93.1	94.4	.....	.....
Clay, Kaolin:							
Short tons	197,341	263,306	231,331	240,982	241,052	247,431	.....
% of total	13.1	15.0	12.7	13.2	12.8	13.2	.....
Clay, Fire & Stoneware:							
Short tons	27,148	9,500	....	9,322	18,475	8,781	....
% of total	0.3	0.1	....	0.1	.2	.1	....
Lime:							
Short tons	715	908	1,126	2,000	1,631	1,555	.....
% of total	.0002	.0002	[d]	[d]	[d]	[d]	.....
Litharge:							
Short tons	1,398	3,047	2,641	2,109	2,230	1,768	.....
% of total	1.2	1.7	1.7	1.5	1.4	1.3	.....
Lithopone:							
Short tons	3,245	4,092	3,295	1,523	1,723	1,701	.....
% of total	4.1	3.9	3.2	2.5	3.3	3.9	.....
Mica, Ground:							
Short tons	3,856	5,776	6,551	5,126	5,668	5,021	.....
% of total	7.0	8.0	9.0	7.0	7.8	6.3	.....
Sulfur:							
Short tons	59,360	75,000	75,000	75,000	80,000	.....	.....
% of total	1.3	1.3	1.4	1.4	1.4	.....	.....
Talc:[b]							
Short tons	53,400	75,900	70,970	64,476	32,137	30,621	.....
% of total	12.0	12.0	11.2	10.9	0.7	.07	.....
Zinc Oxide:							
Short tons	58,496	82,944	71,507	72,774	78,439	71,058	.....
% of total	52.5	51.6	48.4	51.2	52.7	50.7	....

Source: U. S. Bureau of Mines.
Notes: (a) Solid and semi-solid products of less than 200 penetration (b) Includes prophyllite and ground soapstone. (c) Does not include precipitated antimony sulfide as in previous years. (d) Negligible.

Reclaimed Rubber

(Including Natural and Synthetic)

(All Quantities in Long Tons)

Year	New Supply	Consumption: Tons	Consumption: % to Crude[a]	Exports	Stocks On Hand at End of Period
1941	274,202	251,231	32.2	13,851	41,750
1942	286,00.[b]	254,620	64.6	30,405	42,532
1943	304,058[c]	291,082	59.6	15,678	46,201
1944	260,631[d]	251,083	35.3	11,800	43,832
1945	243,309	241,036	30.2	13,413	28,155
1946	295,617	275,410	26.5	14,461	33,666
1947	291,395	288,395	24.8	14,556	35,943
1948	266,861	261,113	24.4	11,428	32,630
1949	224,029	226,679	22.5	10,637	28,263
1950	314,008	303,733	24.1	11,740	35,708
1951	366,700	346,121	26.6	14,722	45,082
1952	274,981	280,002	22.2	11,180	30,664
1953	298,336	285,050	21.3	11,597	32,319
1954	238,101	249,049	20.2	10,232	30,746
1955	326,649	312,781	20.4	13,988	31,498
1955:					
Nov.	29,124	27,229	20.3	1,313	28,473
Dec.	28,153	24,604	20.0	1,347	31,100
1956:					
Jan.	26,205	25,827	19.6	1,382	31,640
Feb.	27,108	25,571	20.3	1,115	31,875
Mar.	28,468	26,176	20.3	1,163	33,326
Apr.	26,933	23,999	19.6	1,179	34,360
May	25,485	23,560	18.9	1,297	34,863
June	22,153	20,049	18.4	1,264	35,647
July	19,776	18,099	18.7	952	35,703
Aug.	21,724	21,498	18.0	1,076	35,512
Sept.	22,368	20,242	17.9	1,015	36,527
Oct.	26,318	23,946	17.8	1,298	37,904
Nov.	20,009	20,832	18.2	1,189	36,063
Dec.	20,566	20,728	17.5	....	34,878

Source: U. S. Department of Commerce.
Notes: (1) These figures are revised from time to time and the latest available issue should be consulted for the most accurate data. (a) Includes natural and synthetic rubber. (b) Includes 893 tons of imports. (c) Includes 67 tons of imports. (d) Includes 21 tons of imports.

Cotton, Rayon and Nylon Tire Fabrics

(In Thousands of Pounds)

	Production: Rayon Tire Cord Not Woven	Production: Rayon Tire Cord Woven	Production: Cotton and Nylon Cord & Fabric[a]	Production: Chafer Fabrics (all fibers)	Production: Total Tire Cord and Fabric	Stocks[b]: Cotton and Nylon Cord & Fabric	Stocks[b]: Rayon Cord and Fabric
1955:							
Jan.-Mar.	20,299	79,191	14,870	12,763	127,123	6,863	44,239
Apr.-June	21,550	81,036	18,898	12,724	134,208	8,870	40,689
July-Sept.	20,740	81,996	16,093	12,941	131,770	9,679	47,272
Oct.-Dec.	24,343	77,600	15,754	12,333	130,030	9,182	46.636
Total	86,932	319,823	65,615	50,761	523,131	34,594	178,836
1956:							
Jan.-Mar.	23,707	74,833	29,298	14,176	129,199	10,185	48,936
Apr.-June	21,557	60,644	28,752	11,628	112,546	10,433	43,737
July-Sept.	18,698	56,961	26,349	7,958	102,575	11,094	44,376
Oct.-Dec.	20,071	55,639	28,515	9,497	104,927	12,500	38,060
Total	84,033	248,077	112,914	43,259	449,247	44,212	175,109

Source: Bureau of the Census, U. S. Department of Commerce.
Notes: (a) Combined to avoid disclosing figures for individual companies. (b) At end of period.

Gasoline Consumption

(In Thousands of Barrels of 42 Gallons)

	1950	1951	1952	1953	1954	1955	1956
Jan.	66,981	80,670	86,863	89,634	89,852	96,397	100,642
Feb.	53,274	72,864	82,043	86,458	86,206	88,464	98,088
Mar.	78,780	86,962	87,065	98,158	101,549	105,684	113,128
Apr.	80,350	87,573	98,563	102,044	103,866	111,116	113,034
May	89,035	100,266	101,137	105,918	104,418	115,707	124,114
June	90,174	96,364	99,305	114,703	113,037	120,710	127,413
July	91,677	100,567	105,307	112,960	112,231	115,653	121,243
Aug.	94,507	101,453	102,954	109,124	110,223	121,816	126,207
Sept.	86,725	91,891	100,095	106,158	104,706	113,379	112,691
Oct.	89,067	100,209	103,689	106,037	105,607	112,558	120,133
Nov.	82,688	88,581	91,326	99,210	102,393	109,212	112,553
Dec.	81,632	84,551	95,817	100,225	104,258	111,034	.....
Total	994,290	1,091,951	1,154,254	1,230,629	1,238,346	1,321,730	.....

Source: U. S. Bureau of Mines.

U. S. Gross Imports of Balata, Jelutong, Gutta-Percha, etc.

(All Quantities in Long Tons)

Year	Balata: Tons	Balata: Value	Jelutong: Tons	Jelutong: Value	Gutta-Percha & Other Guttas: Tons	Gutta-Percha & Other Guttas: Value
1944	1,012	$660,805	88	$45,578	10	$4,999
1945	1,361	907,253	....	.....	36	21,970
1946	2,281	2,233,065	304	256,169	423	458,064
1947	1,982	2,276,531	2,878	1,496,887	392	779,591
1948	1,195	805,078	3,401	2,377,765	423	542,788
1949	1,391	814,554	1,043	834,978	197	189,021
1950	2,117	1,589,885	1,789	1,515,162	541	745,418
1951	2,452	1,973,271	1,669	2,608,359	383	430,539
1952	988	762,994	1,636	2,094,983	282	385,890
1953	1,619	866,248	1,027	1,166,837	235	303,116
1954	949	504,065	2,196	2,624,926	417	511,055
1955	1,022	967,369	1,679	1,731,821	284	318,115
1956:						
Jan.	49	30,670	112	99,777	9	18,066
Feb.	68	57,777	140	137,190	11	13,642
Mar.	164	116,302	135	123,366	17	21,620
Apr.	93	62,425	111	105,593	34	48,766
May	31	22,595	152	159,121	33	34,803
June	99	78,150	248	243,307	15	14,008
July	46	53,177	147	152,950	13	31,774
Aug.	76	89,476	212	225,769	18	21,499
Sept.	195	165,793	103	127,682	5	10,199
Oct.	232	181,337	158	155,523	23	19,254
Nov.	232	194,511	116	144,945	74	45,853

Source: U. S. Department of Commerce.

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15 ton, Consolidated, self-contained; 15 ton, Stokes, 200 D-3.
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40 ton, Loomis, 4 opening, 12" x 12", elec. heated platens, MD self-cont.
50 ton, Baldwin-Southwark, angle molding press, practically new.
50 ton, Stokes, semi-auto., self-cont.
50 ton, Watson-Stillman, 12" x 17", elec. htd. platens, MD pump.
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60 ton, Logan, horizontal extrusion press, 7" ram x 36" stroke.
75 ton, Farquhar, upacting, 30" x 42" platens.
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100 ton, Watson-Stillman, platens 13" x 13", ram 3½" x 3" str., MD pump.
100 ton, Watson-Stillman, 4-post, platens 11¾" x 12", ram 8" x 15" stroke; 100 ton, Watson-Stillman, bed 32" x 20", DLO 24", self-cont.
113 ton, French Oil Mill, 6 opening, elec. htd. platens 15" x 18".
113 ton, R. D. Wood, 5 opening, elec. htd. platens 14" x 20".
113 ton, Stewart Bolling, 20" x 20" steam platens, 12" upmoving ram x 14" str.
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150 ton, Carey, platens 20" x 16" adj., DLO 8"-28".
175 ton, Viceroy, slab-side, 24" x 24" elec. htd. platen with hand pump.
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200 ton, Elmes, 14" ram x 42" str., 24" x 30" bed.
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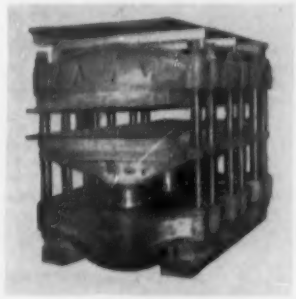

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Rubber Age

COVERING THE MANUFACTURE OF RUBBER AND RUBBERLIKE PLASTICS PRODUCTS

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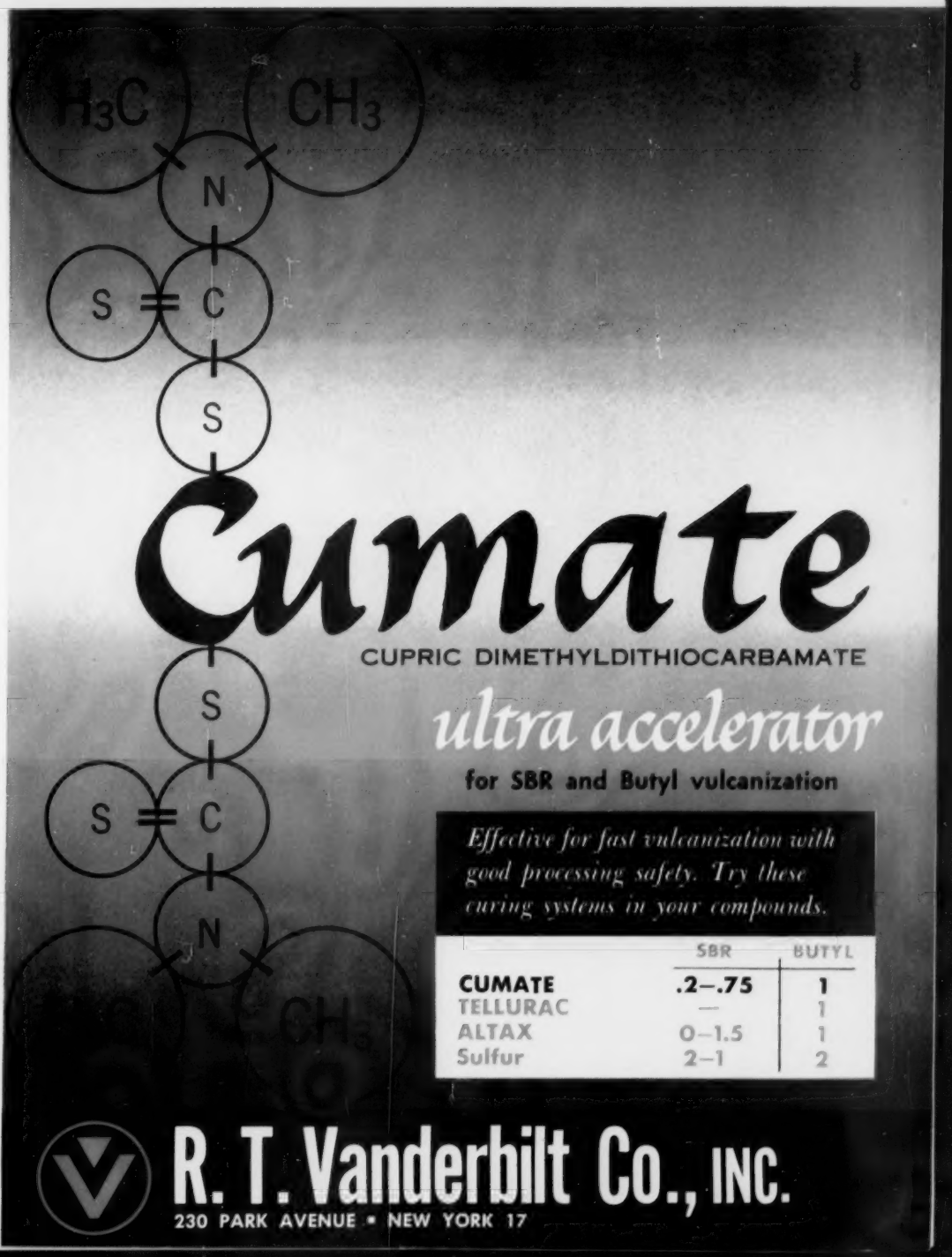
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